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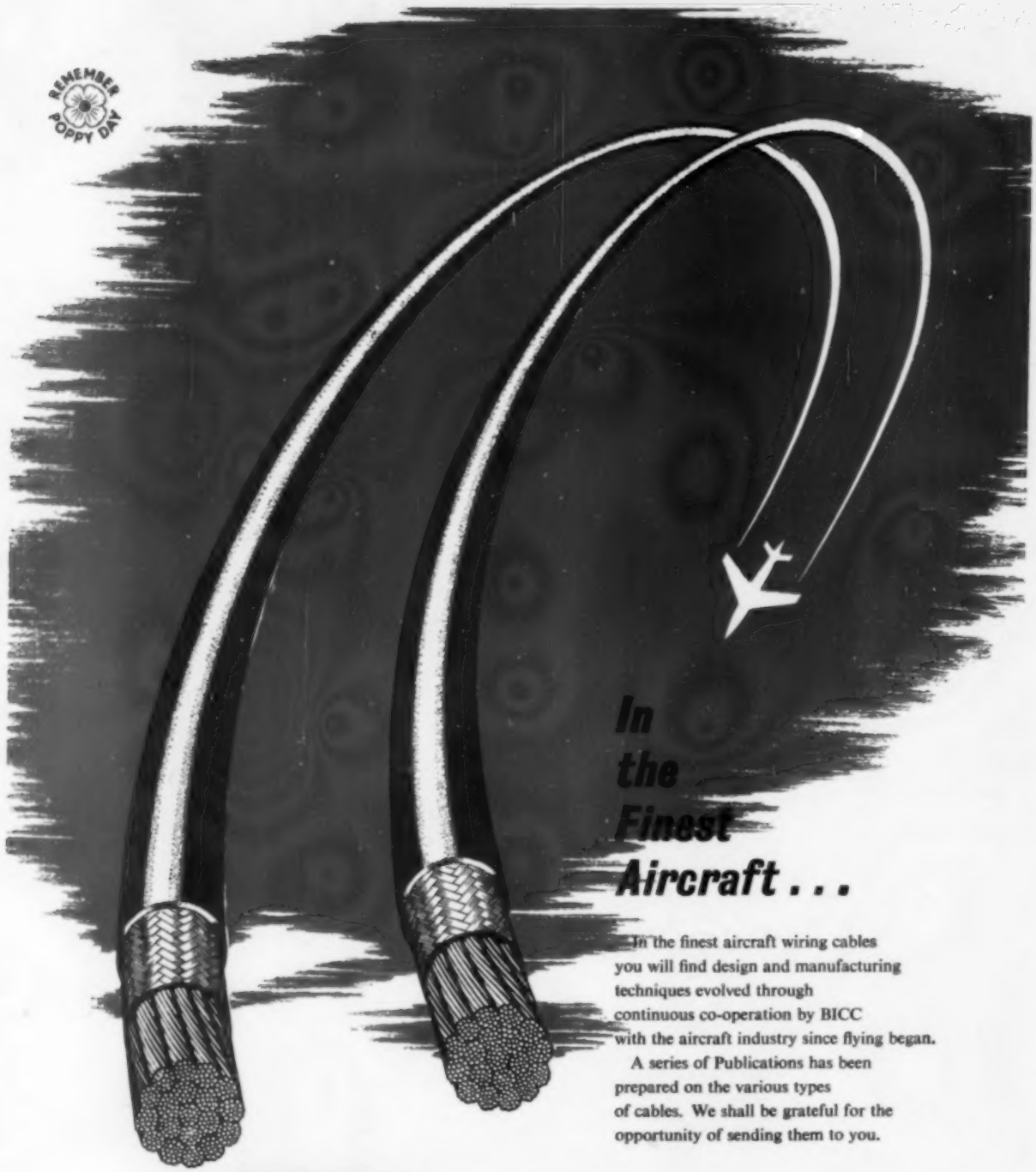

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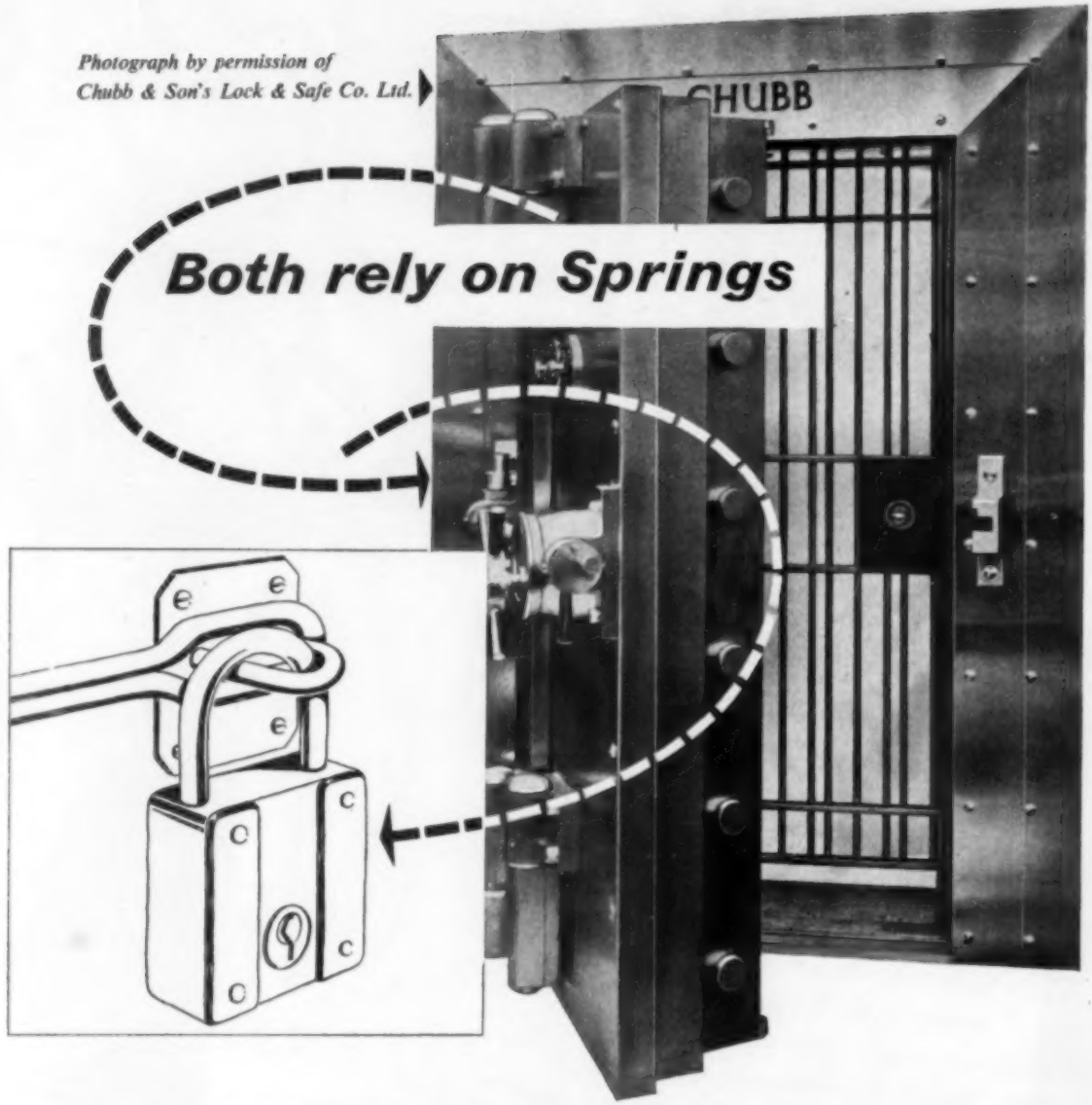

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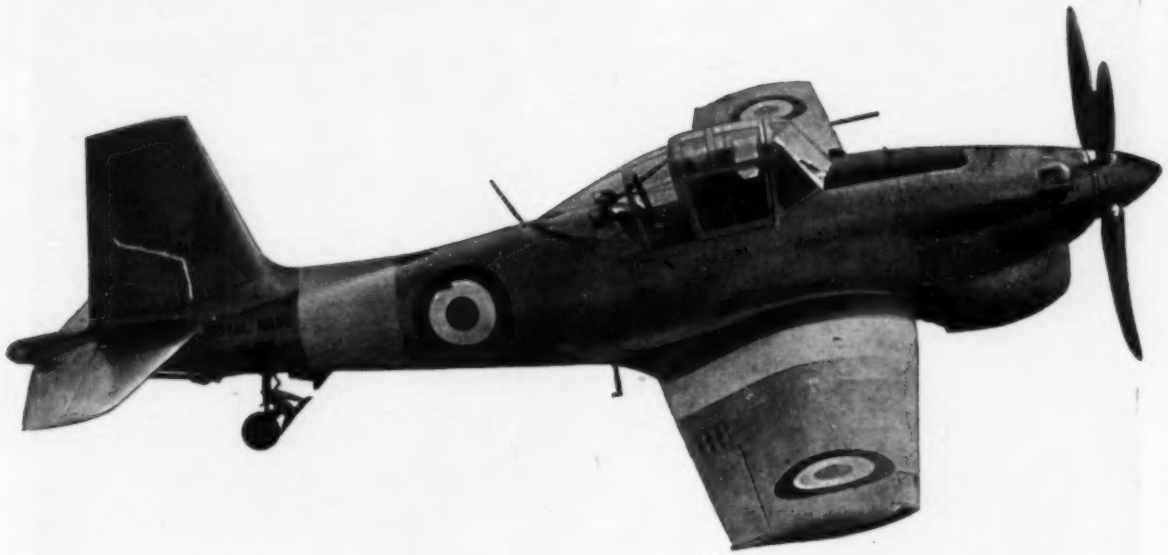

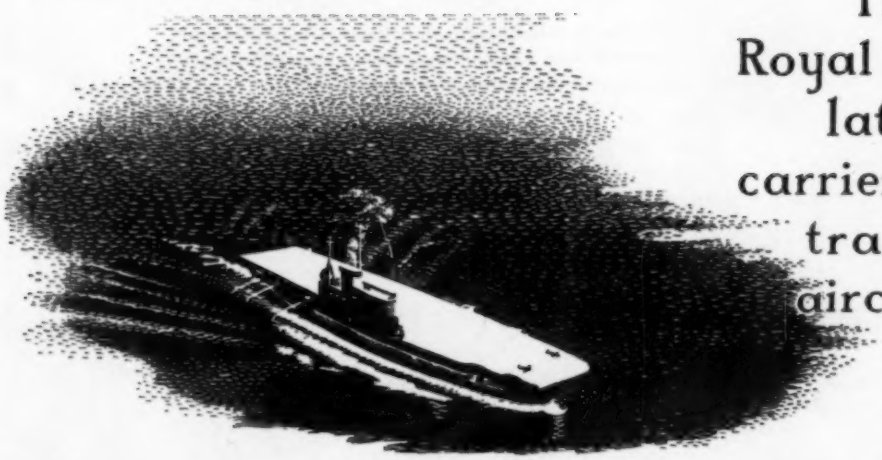

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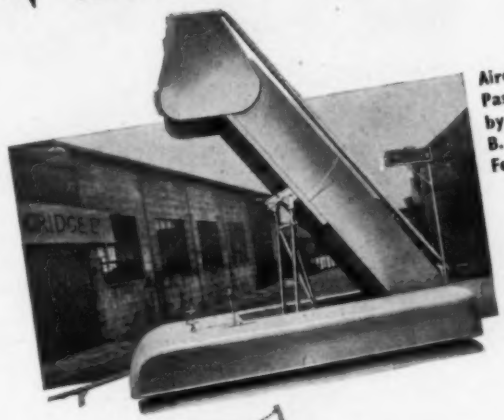
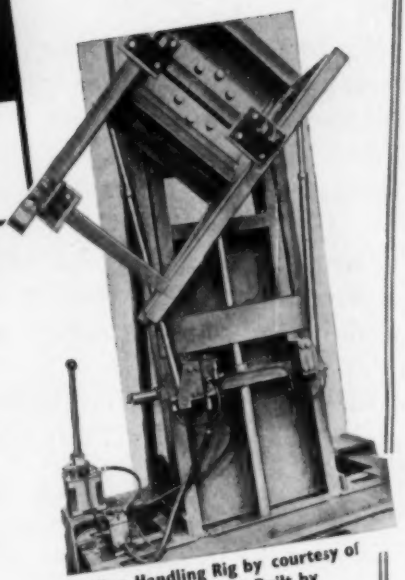


Aircraft Passenger Gangway by courtesy of B. F. Collingridge Ltd. Feltham, Middlesex



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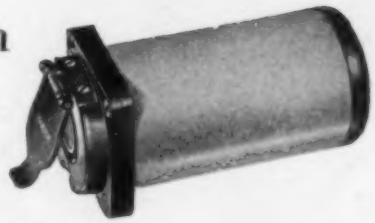

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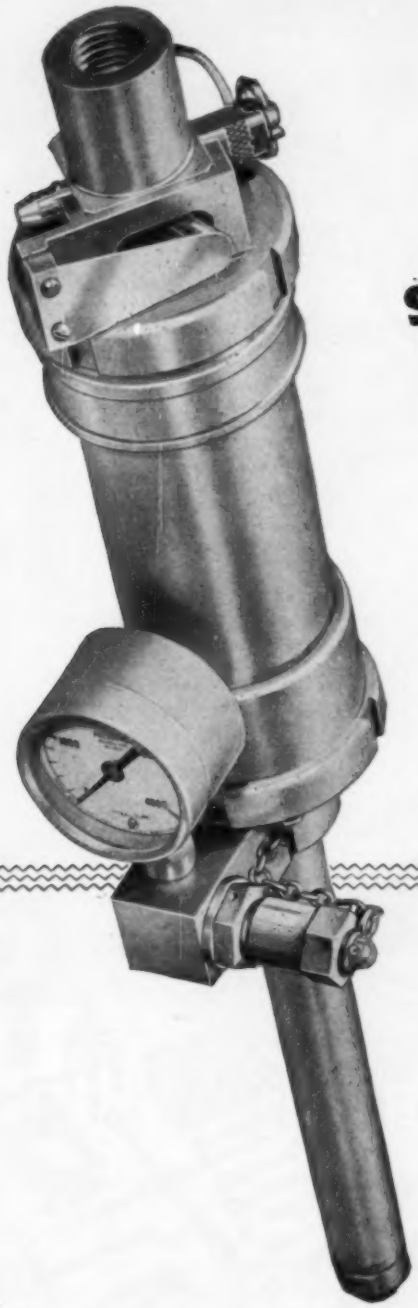

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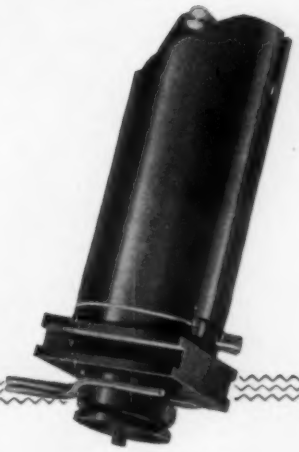

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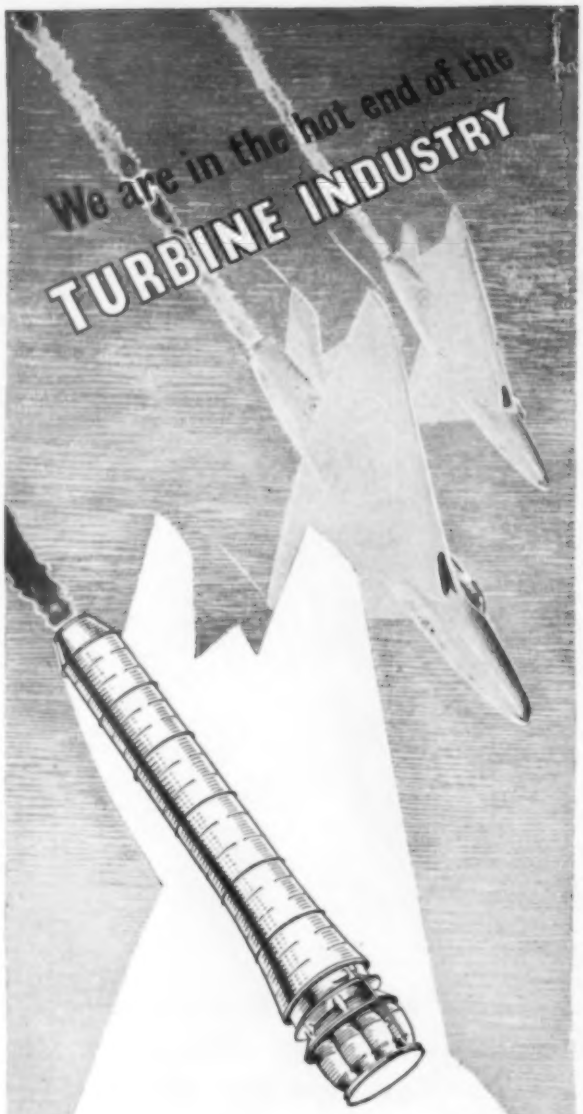

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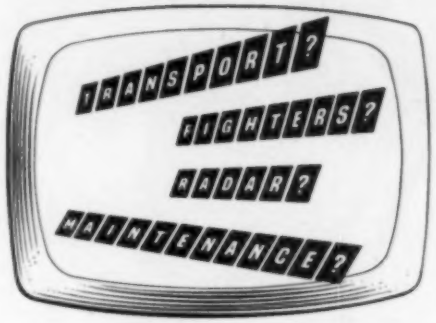

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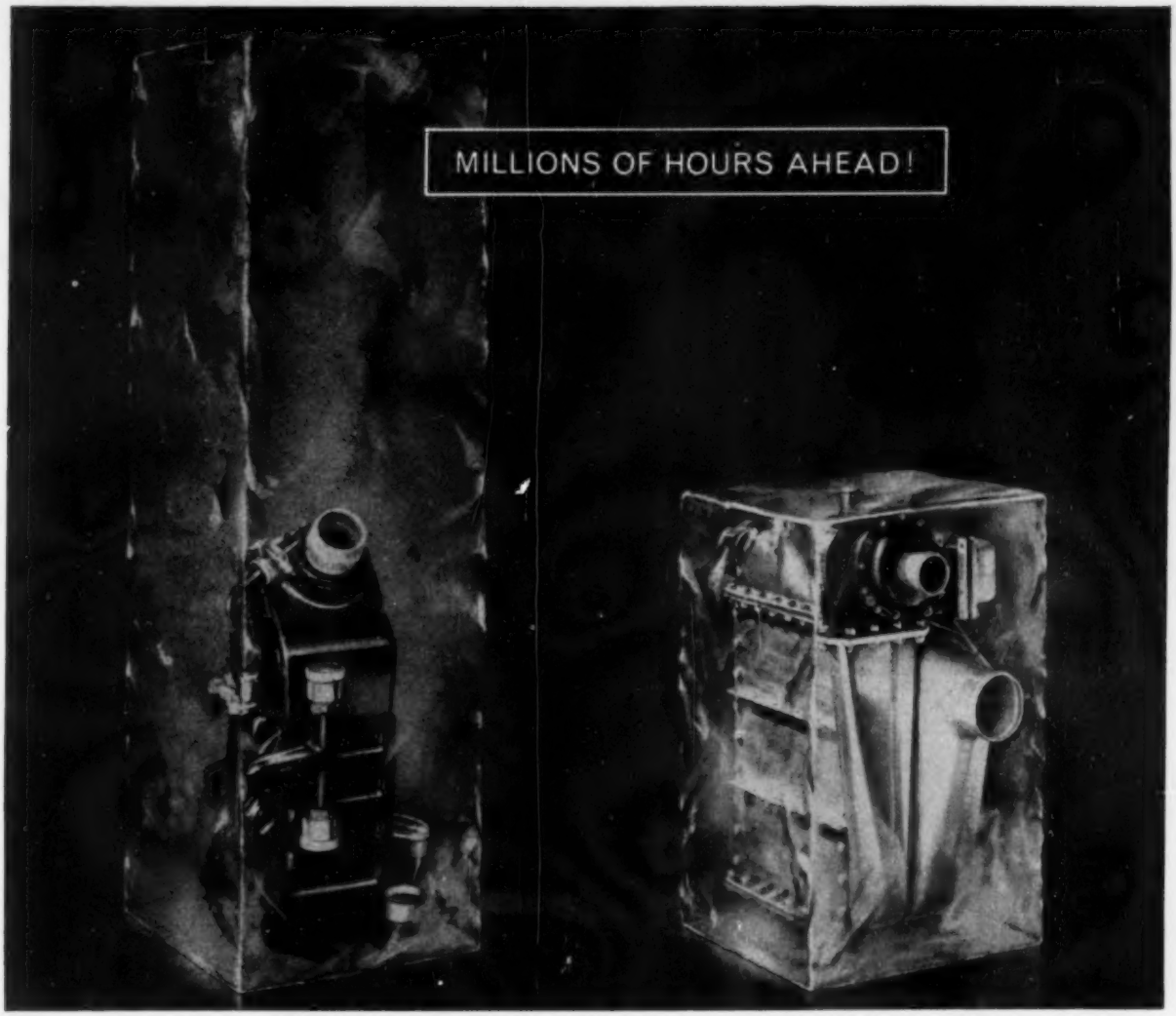

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Founded 1909

No. 2389 Vol. 66. FRIDAY, 5 NOVEMBER 1954

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Making Work

IT is surprising to find that more than two and a half years have elapsed since the Super Priority scheme was announced for aircraft production. It is also sixteen months since Lord Trenchard criticized the time taken to build and develop V-bombers. His opinions were not shared by everyone at the time, but since then the need to speed-up aircraft development has been far more widely realized. Some action has also been taken, though it is still early to expect many tangible results. The decision to order larger numbers of each prototype was an encouraging step; less satisfactory is the fact that there has as yet been little important change in the R.A.F.'s re-equipment position. More Canberra and night fighter squadrons have, of course, been formed, but Hunters, Swifts and Valiants have still to be seen in squadron service. The Hunters and Swifts have been on the verge of delivery to squadrons for some twelve months past. The first Valiants may be allocated to a squadron any day now.

Except in the case of the Midge, there is nothing in the design of the newest prototypes to suggest that aircraft are becoming any simpler, or easier to build; if anything, the contrary is the case. Thus any move which will help to reduce production time gains increasing importance. It is our belief that a great deal more can be done, particularly under the two headings of (a) standardization of components and equipment and (b) liaison between aircraft designers and equipment manufacturers at the earliest stages. There is justification for stating this more strongly: unless something better is achieved in the way of standardization and co-ordination the majority of future British aircraft will appear later and later and so run the risk of being outclassed in service.

In this respect the Americans seem to be ahead of us. Both they—and, more important, the Russians—are no doubt in a position to bring more men and money to bear on such objectives. To keep pace, Britain must thus depend not only on brains, but brains in conjunction with improved planning and co-ordination.

Stitches in Time

Most people will be aware of the S.B.A.C.'s good work in connection with standardization of components such as splined airscrew-shafts, and certain items of cockpit equipment. A valuable contribution is also being made—on an international basis—by the standardization committees of NATO. But much more is required. The improved liaison which we believe to be called for is not so easily arranged, because it requires extra time from experienced technical men who are already, for the most part, overworked. Yet, in quite a short period, time so spent might well bring them a compensatory saving of effort at a later stage.

A great many—perhaps half—of the delays in the development, building and eventual use of aircraft result from late deliveries of essential equipment or eleventh-hour alterations to it. And investigation shows in many cases that the makers of the equipment were given insufficient time to produce and test it, and, as often as not, that they were brought into the picture at too late a stage. We need hardly elaborate on the difficulties and, often, loss of efficiency caused by installing equipment as an afterthought—cockpit conditioning is an example—as compared with designing the aircraft to accommodate it from the start.

And what of the equipment itself? Blind-flying instruments, autopilots, engine auxiliaries, radio sets—this sort of installation is accepted in standard form. But why stop there? Why does every fighter have a different wheel and tyre size, different heaters and coolers and different levers and cockpit controls? Why, in fact, is it almost impossible to find any two like items, small or large, on any two makes of aircraft of the same class, size and performance?

It is our firm conviction that not only could design and development time be saved by limiting the variety of components to do each job in aircraft today, but that, in addition, manufacturing time and money would be reduced, spares provisioning—especially in the Services—simplified, and instructional time for ground and air crews cut down; and all without any loss of operational efficiency at all.

FROM ALL QUARTERS

GROUND-ATTACK TRAINER: One of the group of Hunting Percival Provosts which, as reported last week, recently began their delivery flight to the Burmese Air Force.

Reconnaissance Conference

"THREE exhibits of world interest" were to be among the equipment on display at the Central Europe Reconnaissance Conference which opened this week at Spangdahlem, a U.S. base in Southern Germany. It is known that one of them was the "largest mobile camera ever built"; the nature of the other two was not to be revealed until Wednesday.

This year's "reconnaissance show" was regarded by Allied Air Forces Central Europe as probably the most important event of its kind yet held. Much of the equipment shown was of a kind yet to be brought into operation; one American camera was said to be capable of photographing ground features from 40,000ft "with daylight clarity." The 2nd Allied Tactical Air Force arranged to demonstrate 36 vehicles of the Command Mobile Field Photographic Section, described in our report (October 8th) of Exercise Battle Royal. Aircraft on view included a Meteor F.R.9 and P.R.10, Canberra P.R.3, RF-84 Thunderjet from the Dutch 306 Squadron in 2nd A.T.A.F., and several of the latest U.S.A.F. reconnaissance aircraft. Gen. Lee, commanding 4th A.T.A.F., who were acting as hosts, was to open the conference, which was to be under the chairmanship of A. Core. P. G. Wykeham-Barnes.

Tank-testing Pressurized Transport

NO time has been lost in applying the lessons of the Comet investigations. In particular, the water-tank rig devised at Farnborough to test simultaneously the fatigue characteristics of both the pressure cabin and the wing seems likely to be adopted generally. Giving evidence on Monday, Sir Arnold Hall, director of the R.A.E., confirmed that the sacrifice of a complete airframe for this purpose might be a desirable part of future testing programmes.

We have already reported that the Fokker F.27 Friendship and the Bristol Britannia will be subjected to water-tank testing. Now Vickers-Armstrongs state that similar testing of the Viscount cabin and wings is to be undertaken at Weybridge. In each case these precautionary measures are being taken voluntarily at the expense of the companies involved.

New Lockheed Orders

INITIAL production orders for 17 Lockheed F-104s have now been placed by the U.S. Air Force. The F-104 is a supersonic air-superiority fighter with a straight wing, powered by a Wright J65 Sapphire with afterburner. The contract for a prototype was placed in the spring of 1953 and the aircraft first flew last February; it is now at Edwards A.F.B., together with a second YF-104. Assembly of production aircraft is already taking place.

The Georgia division of the company has received a second production order for C-130A transports (see pages 676 and 677 of this issue), which will extend production of this aircraft at Marietta, Georgia, into early 1957.

T.A.A.'s Loss

ON Saturday last, only 18 days after completing its delivery flight from England, Trans-Australia Airlines' first Viscount, VH-TVA *John Batman*, crashed on take-off and was burnt out at Mangalore, 68 miles north of Melbourne. Three pilots were killed, but the five other people aboard, including the eight-year-old son of the engineer, escaped with relatively minor injuries. First reports say that the aircraft, which was taking off on a practice flight with one engine cut back, swung and turned over twice after hitting a tree. The instructor and captain of the aircraft was Capt. D. K. MacDonald, and the pilots lost with him were Capt. R. D. Fisher and Capt. J. W. Nickels.

This was the first accident to a Viscount involving casualties since the type first flew in July 1948. Mr. G. P. N. Watt, chairman of T.A.A., has described it as essentially a training accident, with nothing to suggest loss of confidence in the Viscount. Vickers-Armstrongs, Ltd., have sent their chief test pilot, Mr. G. R. Bryce, to Australia to help in the investigations.

Franco-Indian

DURING the past year, the 70-odd Dassault Ouragan fighters bought by the Indian Air Force (in which Service they are known as *Toofanis*) are reported to have given good service. In fact, repeat orders are stated to have been sought; and, since the Ouragan has been succeeded in production by the swept-wing Mystère, it is likely that a large number of Mystères will eventually

OFFENSIVE ASPECTS: The upper photograph shows the prototype Dassault Mystère IV-A, powered by a Hispano Tay. As noted on page 665, it has been supersonic with the under-wing load seen. The other photograph shows a Saab S-29C of the Royal Swedish Air Force, carrying fourteen rockets for ground-attack work.

DRESSED FOR THE PART: W/O. Billy I. Wester, of the U.S. Army, at the controls of the Sikorsky XH-39 in which he recently secured an unofficial helicopter height record of 24,500ft.

be supplied to India. The Dassault factory is at present heavily committed to American off-shore Mystère production.

An Indian Air Force mission, under A. Cdre. Lal, is currently touring various French aeronautical establishments. The Air Commodore, together with G/C. Moolgavkar and S/L. Suri, recently flew the Dassault Mystère IV-A (illustrated opposite), and one of the pilots, on his first flight, exceeded Mach 1, in spite of the fact that the aircraft was carrying full armament, two drop tanks and two napalm tanks, all four tanks being tufted for photographic observation. The team also visited all the main S.N.C.A.S.O. factories, and each of the three pilots named above exceeded Mach 1 in a Vautour.

Search for the Missing Javelin

AN intensive search has been in progress in the Bristol Channel for the wreckage of the Gloster Javelin which was lost there on October 21st. The pilot, F/L. R. J. Ross, has not been found and has been posted missing, presumed killed. Altogether, ten Naval craft have, up till the time of going to press, been engaged in the operations off Weston-super-Mare, under the command of Cdr. T. D. Butler, R.N., Boom Defence Officer, Pembroke Dock. The ships have included the boom defence vessel *Barrage*, two tugs, three seaward defence craft, the minesweeping trawler *Flatholm*, the frigate *Venus*, and the two minesweepers *Chillingham* and *Asheldham*.

Under-water visibility and tidal conditions make it impossible to use under-water television and diving operations can be carried out only during the half-hour of the slack tide period; even then, divers have to work entirely by sense of touch.

The search, which continued throughout last week, was intensified on Saturday. Over the week-end, members of the South Wales and Severn division of the R.N.V.R. also joined in the sweep, operating from sea-going tenders. The wreckage of the Javelin was believed to be lying at a depth of between four and ten fathoms. Two of the Asdic contacts made during the week-end turned out to be a rock and an anchor.

NORTHOLT: A DOUBLE FAREWELL

THE last civil aircraft to leave Northolt on a scheduled passenger service was B.E.A. Pionair G-AHCZ *Charles Samson*, flown by Capt. T. Froggatt and operating Flight BE 684. It moved away at its advertised time, 1700 hr on Saturday, October 30th, and was airborne for Jersey from Runway 26 five minutes later.

The passengers had previously participated by invitation, with some 300 other guests, at a joint B.E.A./Aer Lingus cocktail party in the airport restaurant, and spontaneous cheering followed the "calling-up" of this last historic departure. The cheers, however, must have been given with mixed feelings, for Northolt has undoubtedly been one of the happiest and most efficient airports in the United Kingdom, and many were the regrets expressed in the speeches which followed.

B.E.A.'s chairman, Lord Douglas of Kirtleside, recalled his long personal connection with Northolt, commencing in January 1917, when he led a squadron from there to France. (Their hangar was, until the closing, used as the Corporation's motor transport section.) He went on to express the view—the opinion of many—that the flexible, pre-fabricated nature of Northolt, while perhaps looking less than the best, had resulted in "the very nearly perfect airport" from the passenger-handling viewpoint.

In its eight-year association with Northolt, B.E.A. has been responsible for the ground handling of more than 300,000 aircraft movements, and some five million passengers—more than 75 per cent of them from the Corporation's services.

Some appreciative remarks were made about the Airport Commandant, Mr. B. A. Oakley, who was presented with a silver cigarette box by Lord Douglas on behalf of B.E.A. Mr. Max Stuart-Shaw presented Waterford glassware from Aer Lingus. As assistant general manager, Mr. Shaw felt that his company had "just about hire-purchased" Northolt in landing fees, but now regretfully had to move to London Airport and start buying that!

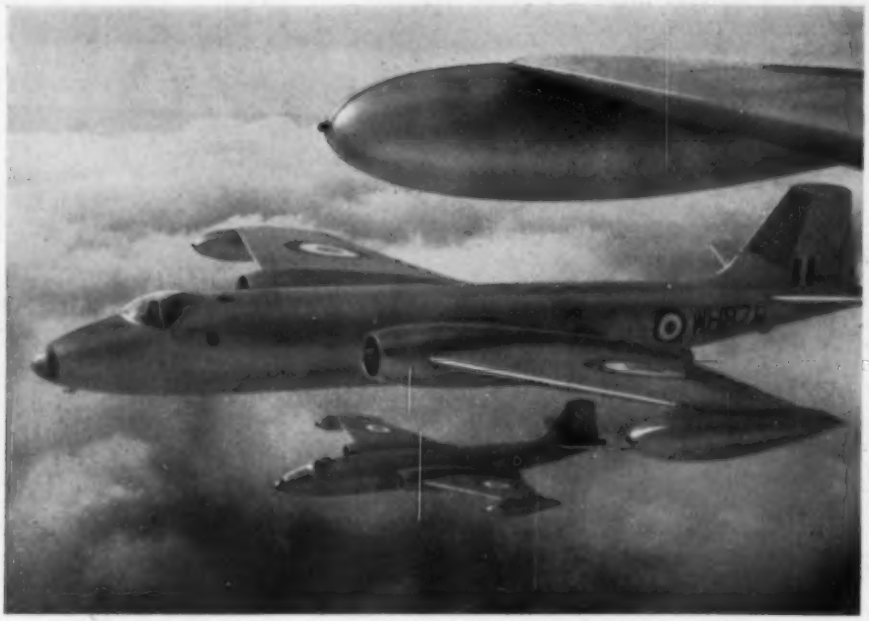
The last actual B.E.A. aircraft movement ex-Northolt was by *Admiral*-class flagship "Item-Victor-Item." This was to be a double farewell, for its repositioning at London Airport was to signify officially the passing from service of B.E.A.'s Vikings.

Mr. George Edwards of Vickers-Armstrongs, the designer of the Viking, paid tribute to the many who helped to make it a success, and this B.E.A./Vickers team-work was again stressed by the Corporation's chief executive, Mr. Peter Masefield, who wound up the proceedings before the final take-off. This was preceded by the departure of a similar aircraft bearing representative B.E.A. long-service employees, including 80-year-old Harry Dawson, who was the first steward on Imperial Airways "Silver Wing" service to Paris in 1927.

So, piloted by B.E.A.'s flight operations director, Capt. Jimmie James, we flew for the last time from Northolt in a Viking, in company with many senior representatives of B.E.A., M.T.C.A., Aer Lingus, Vickers-Armstrongs and the engine division of the Bristol Aeroplane Company. (Ironically, we were held at the runway for an extra five minutes by an unstated aircraft departing from London Airport, thus focussing attention on one great advantage of Northolt's closure—the elimination of overlapping circuits.)

Our wheels finally left Northolt's runway at 2012 hr and its days as a civil airport were over. After cruising *via* Chatham, Sevenoaks and Gatwick this oldest of B.E.A.'s Vikings touched down at L.A.P. at 2053 hr; then it, too, was honourably retired—no doubt to live again with another operator. Thus ended a memorable chapter in British civil aviation. A.B.

AIRPORT NO LONGER: Northolt as it appeared on October 29th, the day before all scheduled civil traffic there came to an end. Until the spring of 1953 it was the busiest airport in the United Kingdom. Now it has been handed back to the R.A.F., whose fighters operated from Northolt until 1944, when Transport Command moved in. The first civil flight from Northolt was on February 4th, 1946.



BOUND for the MIDDLE EAST

PLANS for a goodwill and training flight to the Middle East by six Canberras of No. 57 Squadron were referred to last week. The aircraft are due to leave England today under the command of S/L. I. G. Broom, D.S.O., D.F.C., Officer Commanding No. 57 Squadron, and after flying to Iraq, Jordan and Libya they will return on November 14th. In this ten-day period they will cover some 7,600 miles. The photographs show aircraft of the Squadron rehearsing various formations which they are expected to demonstrate overseas, and on the left are four of the pilots—complete with "space helmets"—taking part, namely, F/O. E. B. D. Coles, F/O. J. F. Goodall, F/L. R. D. Shrivel and S/L. I. G. Broom. In the air-to-air photograph above, a 57 Squadron Canberra may be studied in the standard Bomber Command silver finish.

ELAND-CONVAIR...

. . . and Eland-Ambassador: New Turbo-prop Test-Beds for the Napier Company

IN our issue of July 23rd of this year we fully described the Napier Eland 3,000 h.p. turboprop, and did not disguise our enthusiasm for it. At that time the new engine had already been extensively bench-tested, and its efficiency and excellent control characteristics had been fully explored. The following month, two Elands were installed in a Vickers Varsity lent to the Napier Company, and this machine has since built up a fair total of hours at various speeds and altitudes.

Nevertheless, the Varsity is by no means the ideal form of vehicle in which to mount a modern 3,000 h.p. turboprop, and an agreement has now been reached between D. Napier and Son, Ltd., and the Convair Division of the General Dynamics Corporation for the purchase by Napier of a Convair 340. The aircraft is a completely new machine straight from the line at San Diego, and it is to be flown across the Atlantic this month by a Convair ferry crew, with Napier test pilot Mike Randrup on board (he has been with Convair during recent weeks, together with a number of other Napier engineers, to ensure that no last-minute technical difficulties will arise).

A recent "Flight" photograph of the Eland-Varsity, showing the port engine feathered. This aircraft is as powerful as a Viscount.

Arrangements have already been made to dispose of the Pratt and Whitney R-2800 piston engines which will be used to power the Convair on its transatlantic trip, and design is already in hand for conversion to take two Elands. All the work of conversion is to be done by Napiers, and the programme is also being financed, as a private venture, by the British company. The work of conversion is not expected to be protracted, although it is hoped to achieve an installation much nearer to the optimum than that in the Varsity, in which the original bulky piston-engine firewall and nacelle were retained. It should be flying with Elands early next summer.

At the bottom of the page appears a drawing which we have prepared from a Napier installation drawing, showing the general form of cowling and nacelle selected. The optimum Eland cowling would be much slimmer (3ft diam.) but the Convair installation will have low drag and will require little revision to the nacelle and landing-gear bay. The tail-pipe will pass above the wing. The airscrews will be new units of de Havilland design and manufacture. Inside, the Convair will remain much as before; initially it will have a certain amount of test equipment on board, but full seating, and what might be termed passenger-amenities, will be retained. Some modification will, of course, be made to the fuel system, engine controls and instrumentation.

The Convair will be registered as a normal British civil machine,

The optimum Eland cowling has a diameter of 36in., and this impression shows what could be achieved (on a CV-340) if the original nacelle were rebuilt.

and it is Napier's intention to demonstrate it, on a world-wide basis, as a potential successor to the piston-engined CV-240 and 340 now used by over 15 airlines. Ultimately it is Convair's intention to install Elands in new Convair-Liners from scratch, provided the aircraft attracts a sufficient market. No estimate of the cost either of a conversion of a piston-engined machine or of a new Eland-340 is yet available, but this development will certainly assist Convair in their uphill fight to keep their well-tried transports in service. It would seem that, initially at least, the Elands would go into 340s already built.

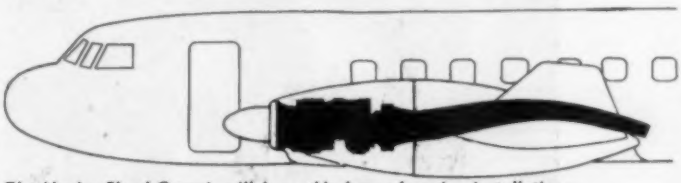
It is not at present revealed whether this development is intended to supplement, or replace, Convair's avowed interest in CV-340s powered by two Allison T56 turboprops or four Rolls-Royce Darts.

Napiers are also going to put Elands into an Ambassador. This aircraft will not be—as was previously thought—the airframe G-AKRD now used by Bristols to assist development of the Proteus 705; instead it will be G-ALFR, one of the pre-production Ambassador 2s cleared to work at 52,500 lb, or 7,500 lb more than is the Proteus-powered machine. This Ambassador is the property of the Ministry of Supply and it is being loaned to Napiers, who will take out the Centaurus 661s and put in Elands. Like the Convair, the Ambassador will be fully furnished. It is not expected, however, to go outside the United Kingdom.

British European Airways are the only commercial operator of the Ambassador—they have 20—and for some time past they have been looking for a new power unit for these fine aircraft. It is not generally known that all the Elizabethan-class airliners were so constructed as to make conversion to four engines a relatively simple matter, and specifications for Ambassadors with four Darts and four of the now-defunct Naiads have existed for years. (Two Nomads have also been suggested, and it is worth noting that a specially equipped Nomad-Ambassador should, on paper, be capable of handsomely beating the World straight-line distance record.) From all this, there can be no doubt that B.E.A. will watch the performance of the Eland-Ambassador particularly closely.

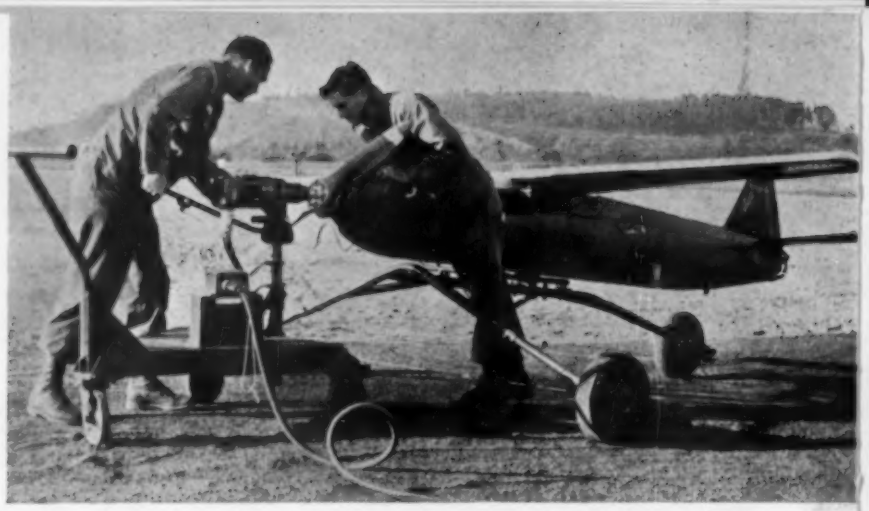
Owing to its American ancestry, the Eland-Convair is very unlikely to be seen at next year's S.B.A.C. show, and the Napier flag will probably be waved there solely by the Eland-Ambassador.

In conclusion, brief mention may now be made of the Series E.153 Eland, which is a refined version, capable of delivering some 4,000 h.p. This puts the Eland into a power bracket at present occupied only by engines of very much greater size and weight. Development of this more powerful version, together with the E.151 power unit for the Fairey Rotodyne, is steadily going forward, and further details will be published as soon as they are available.



The Napier Eland-Convair will have this form of engine installation, with a long tail-pipe exhausting over the wing. The engine is shown in solid black.

HERE AND THERE



"R-CAT" is the U.S. Army name for the Radioplane (Northrop subsidiary) target, seen being prepared for starting at the anti-aircraft range at Grafenwoehr, Germany. The target, which is powered by a flat-four engine, flies itself off from the tricycle launching-undercarriage.

Germany's Aviation Re-awakening

THE name Zeppelin is being perpetuated in the title of an aeronautical research establishment founded at Stuttgart last week. For those wishing to jot down the full name on their shirt-cuffs, it is *Arbeitsundforschungsgemeinschaft Graf Zeppelin.*

Earthquake Relief

THE first 1,500 lb of a 4,000 lb consignment of Red Cross supplies for victims of the North India floods left London Airport on October 28th for Bombay, carried in a Super Constellation of Air-India. The company is flying the loads free of charge.

Dutch Army Helicopter Pilots

IN preparation for the purchase of helicopters for the Netherlands Army, Major C. Sipkes of the Royal Netherlands Air Force is visiting America in order to arrange for the training of the pilots. The Navy already has three S-55s and an S-51.

Saltfleet Range Re-opened

THE R.A.F. bombing range at Saltfleet, Lincs, has re-opened for regular bombing practice. It was closed last December after a number of accidental releases of bombs over land. In May the Under-Secretary for Air said that equipment for radar plotting, then being installed, would permit high-level bombing three or four miles offshore to be conducted without risk of further incidents. That this work had now been completed was stated in a letter last week from Mr. George Ward to Mr. Cyril Osborne, M.P. for Louth.

Comet Inquiry on T.V.

INCLUDED in the B.B.C. Television programme *Panorama* last Tuesday was a feature on the Comet accident Inquiry. Taking part was Ken Owen, *Flight's* editorial representative covering the Inquiry, who explained some aspects of the R.A.E. investigation.

Goal Flight

A PILOT of the R.N.Z.A.F., P/O. McL. Milne, recently made a noteworthy landing when the engine of his Vampire failed to relight at an altitude of 25,000ft during a night flight. Knowing he was some 40 miles north-west of his base at Ohakea, he decided to glide back there. At about 15,000ft he came under radar control, whereby W/C. D. F. St. George, O.C. Flying Wing at Ohakea, brought him over the airfield at about 5,000ft and eventually in to a good landing.

More Norwegian Aluminium

REPORTS from Norway mention the plans of the Oslo firm of Elektrokemisk A/S to build an aluminium works at Mosjoen, in Nordland Province. It is to have an output of 20.000 tons of aluminium a year. Norway's aluminium output last year was 56.000 tons, a figure which should rise to about 100,000 tons next year when the new Sunndalsora works is in full production, while the proposed Mosjoen plant should in due course step up the country's total aluminium output by a further 20 per cent. The Mosjoen plant, however, is not expected to be producing till about 1957. Aluminium production is a new departure for Elektrokemisk A/S.

EVALUATORS of the Gloster Javelin, as related in a news paragraph last week, were (left to right) Major H. Cabolet, Lt-Col. G. De Beuger, and Lt-Col. Roman of the Belgian Air Force.

R.A.E. Appointment

THE Ministry of Supply announce that Mr. H. C. B. Thomas has been appointed Head of the Mechanical Engineering Department at the Royal Aircraft Establishment, Farnborough. Mr. Thomas, who is 54 years of age, has been a superintendent in the Mechanical Engineering Department since 1950.

U.S. Navy Transport Missing

NO further news had been received, at the time of our going to press, of a United States Navy R7V-1 Super Constellation reported missing over the Atlantic between Bermuda and the Azores last week-end. The aircraft, with 42 men on board, was on a scheuled Fleet Logistics Wing service which would have taken it to Port Lyautey, North Africa.

Air Support in Kenya

LINCOLNS, Meteors, Harvards and Piper Tri-Pacers are among the aircraft used to support the Kenya Security Forces' campaign against the Mau Mau. Next week's issue of *Flight* will include a first-hand account of the part played by aviation in the Kenya emergency, written by a member of the editorial staff, Robert J. Blackburn, who has just returned from a tour of East and Central Africa.

Death of a Belgian Pioneer

THE death has occurred suddenly in Belgium of Prospère Cocquyt, honorary chief pilot of Sabena. Capt. Cocquyt entered the service of the Belgian airline in 1924 and piloted its first aircraft to fly to the Belgian Congo eleven years later. After the war he became Sabena's chief pilot in Europe, and in March this year was delegated to helicopter operations, with the title of honorary chief pilot.

Montreal C.A.I. Officials Elected

IT is reported from Montreal that Everett B. Schaefer has been elected president of the Montreal Branch of the newly formed Canadian Aeronautical Institute. He is assistant chief engineer at Canadair, Ltd. Other officers are R. F. Stapells, vice-president; S. Weir, treasurer; H. H. Whiteman, secretary; E. H. Higgins, chairman of admissions committee; R. J. Conrath, chairman of publicity and membership committee; and H. A. Ross, chairman of sustaining memberships committee.

THE COMET INQUIRY CONTINUES

Second Week's Evidence at Church House: the Court Visits Farnborough

FOLLOWING the details of the R.A.E. Comet investigation given in the first week of the Inquiry into the accidents to YP and YY, the second week's evidence amplified the investigations and modifications made by B.O.A.C. and de Havillands before and after the first accident. At the beginning of the third week, Sir Arnold Hall was recalled to give further evidence, which we shall report in next week's issue.

Towards the conclusion of the proceedings on Monday, October 25th, Mr. B. J. Folliard, B.O.A.C. assistant inspector of accidents, was recalled to give details of the passengers, baggage and freight carried in YY on the flight from Rome. There were no unusual features. A meteorological report on the weather at the time and in the area of the Naples accident was given to the court by Mr. P. J. Meade, as for the Elba accident. There was no jet stream, winds would have been southerly and comparatively moderate, and the turbulence to be expected would be only slight.

After Mr. W. G. T. Latimer, B.E.A. station officer at Ciampino, had been recalled to describe the precautions taken prior to the overnight stop of YY at the airport, the final witness, Mr. E. Newton (M.T.C.A.), produced formal documents relating to the registration and certification of Comet G-ALYY.

Thursday, October 28th: Sixth Day.—The wisdom of the Air Safety Board's recommendation that Comet services should be resumed after the Elba accident, and before the cause of that accident had been found, was questioned by Counsel, cross-examining the chairman of the Board. The deputy operations director of B.O.A.C. gave details of the discussions on wing fatigue which had taken place prior to the accident to YP.

Mr. Newton first produced lists of reported route defects relating to pressurization and fuselage cracks experienced on YP and YY, compiled from the respective technical logs and maintenance records, and the aircraft history of YY. Part of this aircraft history read: "From 11th January, 1954, to 23rd February, 1954, special checks were carried out in addition to the routine check 4, on the main structure and control systems. A proving pressure test on the fuselage to 11 lb/sq in was carried out on 15th February, 1954. During this special inspection a number of modifications were introduced affecting the airframe, controls, and fire detection and protection at the engines. The aircraft was returned to service on the 24th February, 1954. . . .

"On the 7th April, 1954, after landing at Rome Airport and whilst investigating a defect in the fuel contents gauge system an engineer found 22 quarter-inch bolts lying loose in the bottom of the port wing. It was found that these bolts belonged to a removable panel in Rib 6. The remaining 30 bolts were in position but not tight. Investigation revealed that this panel had been taken off during the routine check one inspection at London Airport on 29th March, 1954, and had not been properly re-fitted. B.O.A.C. held an inquiry and disciplinary action was taken on the maintenance and inspection personnel responsible. The panel in question was correctly re-fitted before the aircraft took off from Rome.

"The aircraft had flown, at the time of the accident, a total of about 2,704 hours since construction, including 841 hours since its last issue of a Certificate of Airworthiness."

The next witness was Air Chief Marshal Sir Frederick W. Bowhill, chairman of the Air Safety Board and Chief Aeronautical Adviser to the Minister of Transport and Civil Aviation. The Board, he said, had no statutory duties in relation to such matters as airworthiness, but its function was to continuously review the needs of safety in British civil aviation, and to advise the Minister.

After the Elba accident, Sir Frederick stated, the Board was asked by the Minister for advice concerning the resumption of Comet services. On March 2nd, a meeting was held, at which the A.R.B. described their investigations, the modifications they proposed, and the consultations they had had with de Havillands, B.O.A.C. and outside experts. As a result of the meeting, a minute was sent from the Board to the Minister, which read as follows:—

"You wished to have the advice of the Air Safety Board as to whether Comet aircraft should be put back into normal service on completion of the present programme of modifications. The Board has considered all the available information resulting from recent investigations and has noted the nature and extent of the modifications planned as a result. It realizes that no cause has yet been found that would satisfactorily account for the Elba disaster, and whilst the Calcutta disaster is completely accounted for if the aircraft is supposed to have encountered a gust of very great severity (which would have broken any other aircraft) we cannot eliminate that the accident might have been due to some other cause which was possibly common to both disasters. Nevertheless, the Board realizes that everything humanly possible has been done to ensure that the desired standard of safety shall be maintained. This being so, the Board sees no justification for imposing special restrictions on Comet aircraft. The Board therefore recommends that Comet aircraft should return to normal operational use after all the current modifications have been incorporated and the aircraft have been flight tested."

Mr. J. M. Shaw (for the personal representatives of a number of the deceased passengers and crew-members): I wonder if you can help me to try and understand this recommendation you made. You appreciate of course that the relatives of the passengers who died in this crash are very perturbed about this matter of the Comets being allowed to fly again and are very anxious to be reassured about it. The first thing is this that you say in this Minute: "It"—that is the Board—"realizes that no cause has yet been found that would satisfactorily account for the Elba disaster." When you passed this Minute, what did the Board consider was the probable cause of the Elba disaster?—We did not know.

At your meetings were any theories put forward as to what it was thought might have been a cause?—We considered every point we possibly could.

Did that include some failure of the pressure cabin?—We had considered that.

In considering the dangers of metal fatigue were you able yourself to form an opinion as to the dangers of that or did you rely on the advice of the other members of your Board?—I relied on the technical outside advice we got and on the other members of the Board.

So at the time when you passed this Minute the position remained that the cause of the Elba crash might have been due to some defect in the design or manufacture of the aircraft?—We did not think so.

If you did not think it was due to that what did you think it was due to?—We did not know. I mean to say we were not certain. We thought the modifications which were introduced would cover all the points which were humanly possible to prevent any further accident.

Except fatigue?—No, not necessarily except fatigue. I think some of the modifications helped in any question of fatigue.

Concerning the earlier Calcutta accident, to Comet YV, Sir Frederick said the Board's information included a short R.A.E. report on this accident by Walker and Ripley, in addition to the report of the Indian Court of Inquiry. Asked by Mr. Shaw whether he was satisfied that the Calcutta accident was purely due to weather conditions, or whether he had any doubts that it might have been due to some defect in the aircraft, Sir Frederick replied that they were not certain about it.

Mr. Shaw: You had in mind the possibility of a common failure on both these aircraft?—There might be, yes.

And yet you recommended the Minister that they should be allowed to fly again?—That is what I have done in this Minute.

How many aircraft would have to crash from an unknown cause before the Air Safety Board recommended they should not be allowed to fly any more?

Lord Cohen (Commissioner): That sounds to me very like a question addressed to a Jury rather than a proper question to address in this Inquiry.

In reply to a question by Sir Hartley Shawcross (for de Havillands), Sir Roderick agreed that the A.R.B., the American C.A.B., and I.C.A.O. all considered that the risks of damage to a pressure cabin from fatigue, or otherwise, would be guarded against by certain factors of strength over and above working loads to which the cabin would be submitted.

Mr. MacCrindle (for the British Air Line Pilots Association) asked the witness whether he was aware that the Elba accident might have been caused through metal fatigue. Sir Frederick replied "Yes."

You were aware, I suppose, that one of the best ways of finding out whether fatigue has affected the pressure cabin or other parts of an aircraft is to examine the wreckage?—Yes.

And that if you want to be safe, if you want, to use your own words, to do everything humanly possible, it is advisable to look at the wreckage as much as possible, is it not?—Yes.

Looking back on it, do you not think that this expression "everything humanly possible has been done" is putting it much too highly?—I do not think so, no.

Do you not agree with me that it would have been humanly possible to wait a little longer until you had more wreckage?—Well, we could have.

You could, could you not?—Yes, but I do not consider the Minute I wrote was in any way—

It would have been humanly possible, would it not?—Yes, it would have been humanly possible.

Questioned further by Mr. T. Humphrey Tilling (for the Navigators and Engineer Officers Union), Sir Frederick said that at the time of the March 2nd meeting he personally thought that it was rather unlikely that any further wreckage would be recovered.

A quotation from the Farnborough report on the Calcutta accident was later read to the Court by Mr. Shaw. This stated: "Examination of the wreckage revealed no obvious structural defect. No fatigue cracks were found, and all the main fractures were caused by direct loading and not by fatigue . . . it is considered desirable to strength-test a representative tailplane system to destruction. . . . The tailplane had not been tested to destruction in the design stage, though certain proof tests were made."

Further extracts from this report, given by Sir Lionel Heald, included the main conclusion that the probable cause of the Calcutta accident was structural failure under a severe down-gust in a storm of such violence that no transport aircraft could have been expected to survive. It was also possible, the report stated, that the pilot unwittingly or

THE first section of this week's report on the Comet Accident Inquiry appears on pages 686-7: it deals with the evidence up to Monday, October 25th. On Tuesday, October 26th, the Court visited Farnborough to study the wreckage recovered and the methods used in the R.A.E. investigation, and on Wednesday reviewed in private the results of the visit. On this and the following page, which closed for press later than those mentioned above, the second section of this report is given, concerned mainly with the proceedings during the latter part of the week.

THE COMET INQUIRY CONTINUES . . .

unavoidably contributed to the severity of the gust-loading conditions in his attempts to maintain control. "An alternative possible explanation is excessive application of the elevators through malfunctioning of the power-operated control system or automatic pilot. . . . Such limited evidence as there is, however, does not support this alternative explanation and is in general against it."

Two B.O.A.C. inspectors, Mr. L. East and Mr. L. P. B. Fowles, next gave evidence that they had signed the certificate of maintenance following the check one inspection of YY at London Airport on April 2nd, 1954. Mr. G. A. Bull, one of the Corporation's maintenance engineers at Rome, was then recalled: he stated that, while checking the centre fuel-tank contents-gauge system on YY at Rome on April 7th, he observed that the rib 6 inspection panel between the rear spar and the wheel well wall was not in place correctly—a number of bolts were missing from the panel, and were lying about in the wing, and the remainder were not tight. There being no apparent distortion or cracks, the panel was then refitted correctly.

A new co-axial cable for the contents gauge system was found necessary, and had to be obtained from London, Mr. Bull continued. This resulted in a 24-hr delay to YY at Rome. On the next day, the pre-flight checks, taxying and take-off of YY were normal, apart from a "hot spot" on one engine.

Further details of the work carried out on YY at Rome were next given by ground engineers Mr. D. W. Foote, Mr. J. E. Cook, Mr. P. R. Warden and Mr. F. Cuffaro, and in an affidavit by Mr. Rogers.

The next witness was Mr. Charles Abell, deputy operations director (engineering) of B.O.A.C., who was first examined (by Mr. J. P. Graham, for the Crown) on the route defect report concerning YP. He said that none of the 82 pressurization defects recorded during the life of the aircraft would have caused any undue surging of the pressure in the cabin, and the safety valve would have relieved any pressure above 8½ lb/sq in. The defects were really corrections and adjustments to apparatus in the normal course of events, and were the type of defects one expected in a highly automatic pressure-control system.

The fuselage cracks recorded for the non-pressurized area of the fuselage, Mr. Abell stated, were in his opinion caused mainly by buffeting from the jet efflux. In the pressurized area, the majority of the damage had appeared round the passenger entrance door, and was apparently caused by passenger steps and similar equipment being pushed up alongside the aircraft. Maintenance steps were the apparent cause of similar cracks on the opposite side of the fuselage. Mr. Abell gave details of the repairs made in these areas, after which a proof pressure check to 11 lb/sq in. had been carried out. The same general remarks on both pressurization defects applied to Comet YY: there had been in addition lightning-strike damage to the top of the fuselage of YY which had been repaired by the Corporation.

Concerning the 22 out-of-position bolts in the rib 6 panel of YY, Mr. Abell said that the panel had been removed for a fatigue-crack inspection instigated after the Elba accident. An inquiry had shown a misunderstanding on the change-over between two shifts, and the two men most concerned had since been reprimanded.

Although the particular drill and routine sheets for inspection of wing fatigue were made subsequent to the Elba accident, Mr. Abell stated, there were continual discussions on wing fatigue prior to the accident. Towards the end of December 1953, B.O.A.C. received information that a crack had developed in the reinforcing plate on rib No. 3 at the front spar on one of the wings of the prototype aircraft being tested for fatigue at Farnborough. At the time of the Elba accident, when the first cracks were beginning to show on the prototype under test, B.O.A.C. was carrying out a general inspection for wing fatigue-cracks, and discussions were taking place with both the R.A.E. and de Havillands.

After the Elba accident, the Corporation ceased Comet operations and a programme of investigation was arranged together with the de Havilland company. Firstly, the remaining Comet aircraft were to be inspected, and secondly, consideration was given to all possible features which might have resulted in the accident. The possible causes were: 1, Control flutter; 2, primary-structure failure; 3, flying-control failure; 4, fatigue, and particularly wing fatigue; 5, explosive decompression of the pressure cabin; and 6, "the possibility of malfunction of either the engines or the installation, which might cause fire or might cause a major structural failure of the engine, or any other thing which would cause a failure in the aircraft." Inspections and modifications were introduced to guard against these contingencies.

Preliminary medical evidence, Mr. Abell said, had indicated an explosion, and special attention was therefore paid to the possibility of such an explosion occurring in either the equipment bay or one centre-tank area. Modifications to make the electrical system more reliable, and more flame-proof, and in some cases to reduce operating temperatures, were made.

Friday, October 29th: Seventh Day.—Mr. Charles Abell continued to give evidence concerning the modifications to B.O.A.C.'s Comets after the Elba accident, and was cross-examined at length on detail points by Counsel. The head of the R.A.E. Accident Investigation Section outlined the steps taken in the investigation of the wreckage of YP, and gave examples of evidence which contradicted the reported submission of Mr. Jablonsky that a failure of the Redux bonding had caused the Elba accident.

Mr. Abell first referred to the possible fire hazard arising from the use of the hydraulic fluid, which had been tackled in three ways. In addition to investigating possible sources of ignition, they had introduced modifications to prevent any leakage of hydraulic fluid, and to improve the ventilation of all the closed areas in the aircraft. The sixth point, concerning the engines, was dealt with from the viewpoints of possible structural failure of the engine, and possible fire or explosion originating in the engine bays.

Concerning the first of these, Mr. Abell said: "We discussed this matter at great length with the de Havilland Engine Company and with the A.R.B., and we examined all previous records of Ghost engines and test work that had been done. After very careful consideration the de Havilland Engine Company were able to convince all concerned that the only possibility—and that was a remote one—was that of a turbine-blade failure." Inspection of the engines from the Calcutta Comet had confirmed that there had been no failure of the main rotating assemblies. Modifications after the Elba accident included the addition of steel-plate protection, against turbine-blade penetration, for the fuel tank and the main aircraft structure, and precautions against fatigue failure of the impeller and diffuser vanes.

After describing the study of further possibilities such as the explosion of the crew's oxygen bottle, and of a retracted tyre, Mr. Abell stated that the list of modifications which had been carried out after all these investigations, had been devised to cover the worst possible combinations of circumstances which it was thought might arise.

Cross-examined by Mr. L. G. Scarman, O.B.E. (for the A.R.B.), Mr. Abell agreed that about six Comets were given proof tests on their pressure cabins of 11 lb/sq in after the Elba disaster, including aircraft YY. The witness next explained to Mr. Shaw (for the personal representatives of a number of the deceased passengers and crew-members) the practice of "locating" cracks by drilling holes at their ends, to prevent their propagation, and of putting rivets in the holes to prevent any leakage.

Mr. Shaw: We know that in fact the cracks which had been stopped in this way had spread, as we have seen from the photographs, on both YP and YU; is that only something which you have learnt since these investigations, that a crack stopped in that way might propagate further?—No. I think it is generally known that, if you do stop a crack with a locating hole, there is quite a good chance of the crack spreading beyond that hole.

If location of a crack was considered a temporary repair, Mr. Abell said, a procedure existed whereby a permanent repair would be made either within a given time or at the next check period.

Mr. Shaw: When did you first know of these manufacturing cracks on YP or any of the other Comets?—I cannot be sure of the exact date but it was subsequent to the Naples accident.

The recommendation that Comet services should be resumed after the Elba accident, following the modification programme and assuming satisfactory flight tests, had been a joint decision by the A.R.B., B.O.A.C. and de Havillands, Mr. Abell later stated. The cause of the accident was still unknown at that time, he agreed.

In reply to a question by Sir Hartley Shawcross (representing de Havillands), Mr. Abell agreed that cracks developing in the course of the life of an aircraft were well known in the case of aircraft other than the Comet. The cracks which were beginning to appear in the wing of the prototype aircraft at Farnborough at about the same time as the Elba accident, Sir Hartley suggested, in so far as they corresponded with the wing in the production aircraft, occurred at the equivalent of 6,700 flying hours. Mr. Abell answered "I believe that is the position approximately."

Sir Hartley: That was about double, and in many cases more than double the life of any aircraft in service?—That is true.

Sir Hartley went on to quote from the schedule laid down for the detailed inspection of YU and YY after the Elba accident.

After further cross-examination, Mr. Abell was re-examined by Mr. Graham (for the Crown), who produced concession forms made out by de Havillands, under A.R.B. authority, for the manufacturing cracks in YP mentioned during the earlier evidence. The B.O.A.C. inspector at the factory, and A.R.B. inspectors, said Sir Hartley Shawcross, had access to such forms.

The next witness was Mr. E. L. Ripley, head of the R.A.E. Accidents Investigation Section, Structures Department, who had been in charge of the examination and the interpretation of the wreckage of Comet YP. Outlining the investigation, Mr. Ripley said that the first step had been to reconstruct the wreckage, when major separations could be seen. Discontinuities of fire damage and water damage had shown that the structural break-up had occurred in the air before water impact, and that fire had occurred after the structural failure in the air.

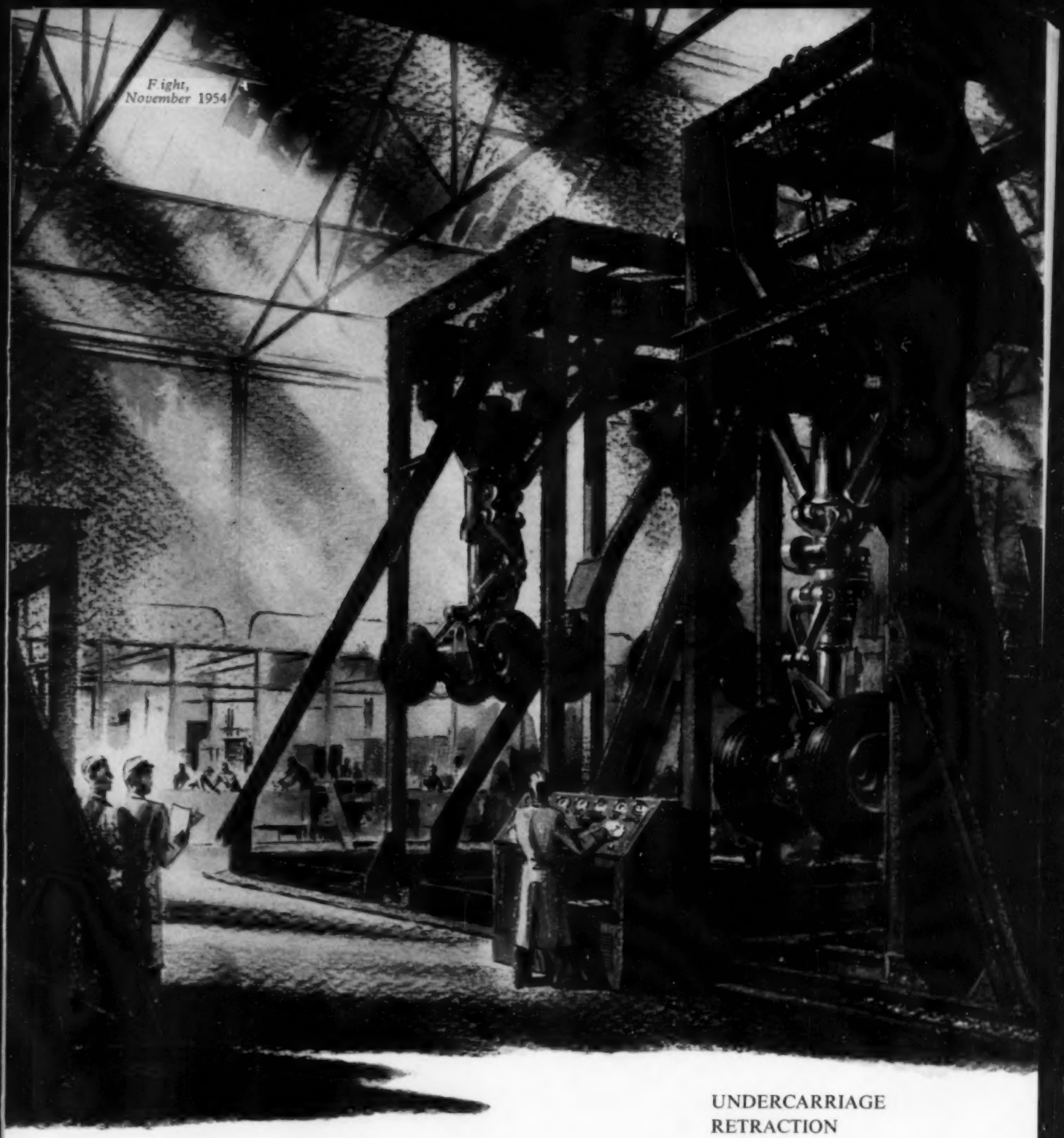
The next step, Mr. Ripley stated, was to examine the major failures and identify their type. Bending, tension, torsion and fatigue failures each had distinctive characteristics, and the fracture-analysis technique could be applied to determine the direction and type of tears. Thirdly, one needed to find the sequence in which these failures occurred on the aircraft: one useful indication here consisted of marks made by one piece of wreckage as it passed over another.

Fourthly, other factors were considered in an attempt to decide the cause of the accident. These included the aerodynamic characteristics of the aircraft, its design history, the stresses for which it had been designed, and the actual loading shown to have been received in the accident. The evidence of water damage was again very useful.

After giving examples (including illustrations from the R.A.E. report) on each of these points, and mentioning the conclusion reached (previously outlined by Sir Arnold Hall), Mr. Ripley showed how a possible explosion in the fuselage had proved contradictory to the evidence of the wreckage. Sir Lionel Heald gave the first official indication of Mr. Bruno Jablonsky's theory by stating that "We have heard from Mr. Jablonsky that he was particularly interested in the question of the Redux adhesive." Sir Lionel went on, "I would like you to assist the Court upon this question whether there are any signs to be obtained from examination of the wreckage that the failure of Redux in any way contributed to the break-up of the Elba aeroplane when the pressure cabin gave way." Mr. Ripley replied, "I have found no signs whatever in the wreckage which would suggest that the failure of Redux contributed to the cause of this accident."

Questioned by Sir Lionel concerning the Farnborough report on the Calcutta accident, which was described as a preliminary report, Mr. Ripley said that a fuller report had not yet been written, largely because of the Elba accident; "We turned all our resources to deal with that wreckage."

(To be continued)



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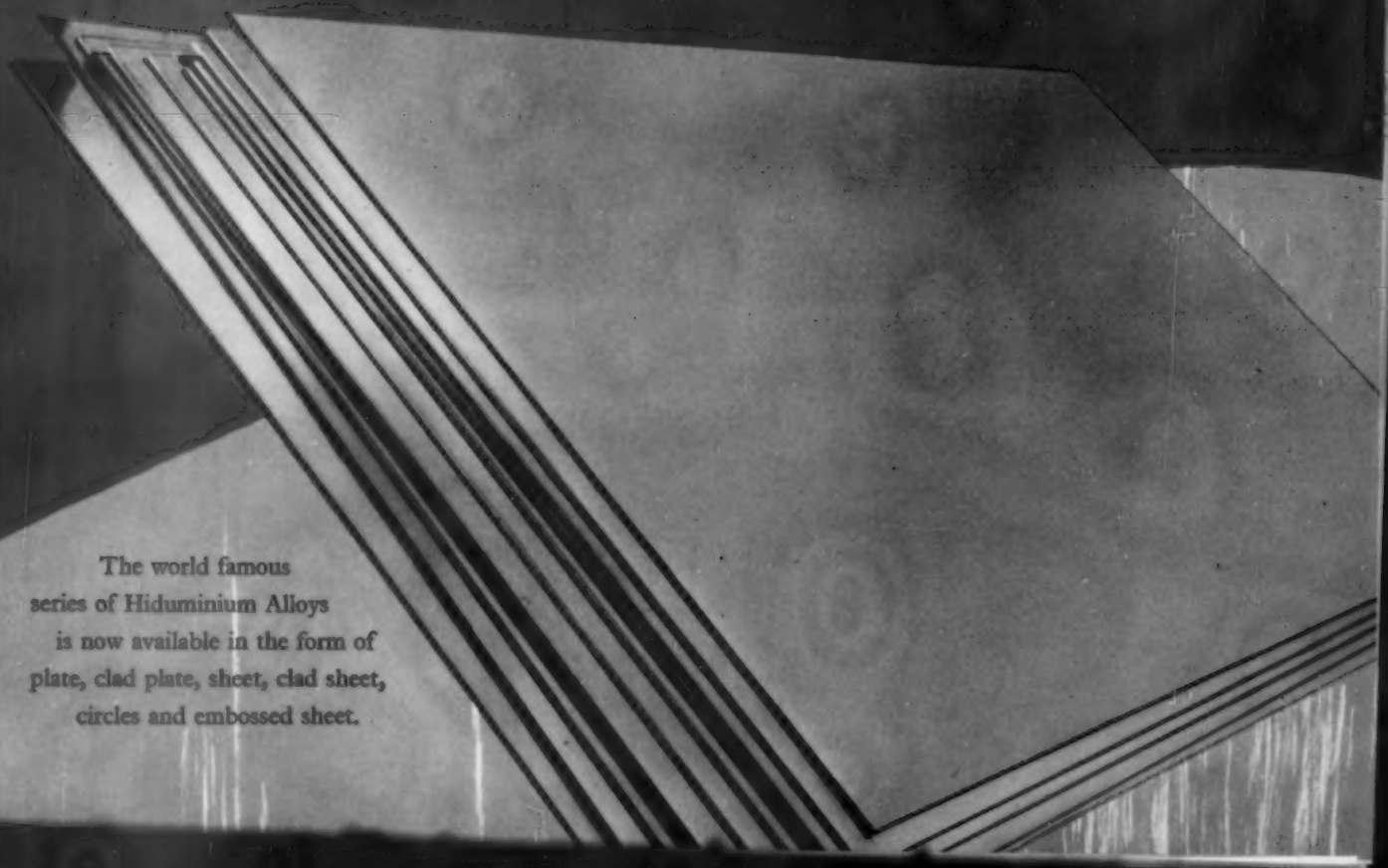

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"Flight" photograph

LONG-RANGE BATTLE

Big-airliner Prospects for the Immediate Future

GENERALLY speaking, the large long-range airliner takes longer to develop than does any other type of aircraft. One can, therefore, reasonably attempt to assess such aircraft for several years ahead—say, up to about 1958. At the present time, however, no one can be certain of what the ultimate effects of the Comet inquiry will be. This is pertinent for, although the Comet 1 was not a long-range aircraft, the problems that the inquiry has raised have already profoundly affected the designers of all large, high-flying aircraft.

No useful purpose would be served by commenting on the future prospects of the Comet, or indeed of any similar aircraft or project, such as the Boeing Jet-Stratoliner or Vickers V.C.7. There seem to be only two really promising lines of development to meet the needs of global airlines during the late 1950s—the Bristol Britannia and the various developments of the Douglas DC-7. This, at any rate, seems to be the opinion of B.O.A.C., and indeed of several other operators. B.O.A.C. are already heavily committed to the Britannia; some other airlines have decided to try to standardize on the later Douglases, but most will—if time permits—sit on the fence until the big Bristol airliner has shown what it can do under service (or simulated service) conditions.

The Britannia is, of course, already pretty fully understood and it promises to be a world-beater; but the fact remains that a machine of this calibre costs a great deal of money (the Belgian airline Sabena, for example, could buy no more than two Britannias with their entire share capital) and very few airlines can afford even the slightest risk of picking the wrong aircraft. The temptation to take the easier way out and buy a possibly inferior but well-tried machine is, therefore, hard to resist.

The Britannia 100 has already been fully described in our pages and only three weeks ago we published an account of the preparations that B.O.A.C. were making for their coming fleet of 15 of these machines. A Britannia 100 can carry roughly twice as many passengers as can an Argonaut, and it can fly considerably further; London to Cairo, for example, would be quite an acceptable stage. It is not, however, looked upon as a transatlantic machine on a year-round basis. The total tankage of the 100 is 6,800 Imp. gal, sufficient for a total still-air range, without allowances, of better than 4,000 statute miles with a 25,000 lb payload, cruising at about 340 m.p.h. This performance alone should revitalize B.O.A.C.'s position, without even allowing for the Britannia's passenger appeal, efficiency and flexibility.

The Britannia 100s are being built now, for delivery throughout next year. As we commented three weeks ago, there is a strong probability that they will not be cleared to carry passengers in normal service until the basic type has completed an unprecedented amount of flying—including, for example, some 2,000 hr on one aircraft. This is a logical outcome of Comet experience and in no sense reflects upon the Britannia. It may be that B.O.A.C. will not have the type in service until 1956; but they should, by then, have almost their full fleet, and no other airline can have anything better, or even comparable, at that time.

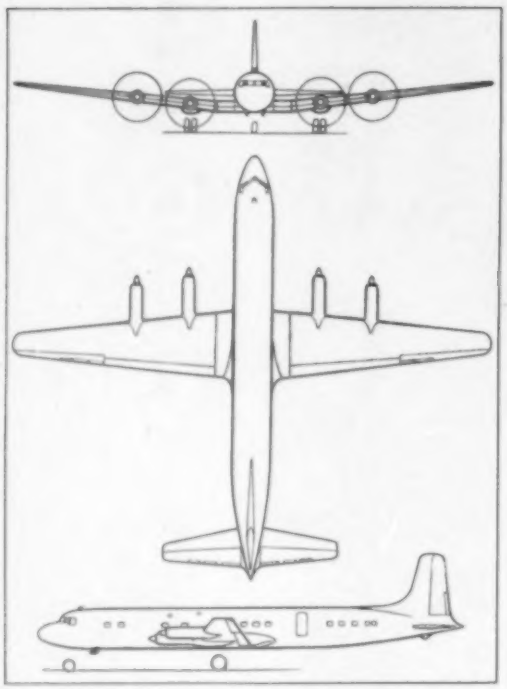
Digressing for a moment upon the vexed question of pressure-cabin fatigue, it is worth noting that a mandatory limit *might* be applied to British civil transports restricting cabin pressure differential to about 6 lb/sq in. This measure of prudence would virtually ground any Comet that had to make a profit, but it should not have much effect on the machines operating now. Those which can equal this limit are the Viscount and Stratocruiser, and both of these can cruise comfortably at less than 25,000ft with a differential of no more than 5 lb/sq in. The Britannia has a design dP of 8.3 lb/sq in (5,000ft interior at up to 32,500ft), but the flexibility of the design is such that it is possible to cruise at well under 30,000ft; if the interior were set to rather more than 5,000ft, the 6 lb/sq in limit could readily be met.

The Britannia fuselage is a superb example of a modern aircraft structure, and it has a lower weight than several other types of transport fuselage of considerably less capacity. The basic skin gauge is 19 s.w.g. (0.040in) and the design is such that cut-outs are very few; those that are unavoidable are mainly of the optimum elliptical form. Joints are generally high-quality riveted connections, with the rivet head accurately spin-dimpled; there is, however, some Reduxing. We stated last week that a Britannia would be exhaustively examined for possible fatigue. This is an obvious measure, and there is no reason to doubt that the aircraft will show up well. Predictions are ill-advised where fatigue is concerned, but there is no reason for thinking that the Britannia programme will be retarded by the new requirements.

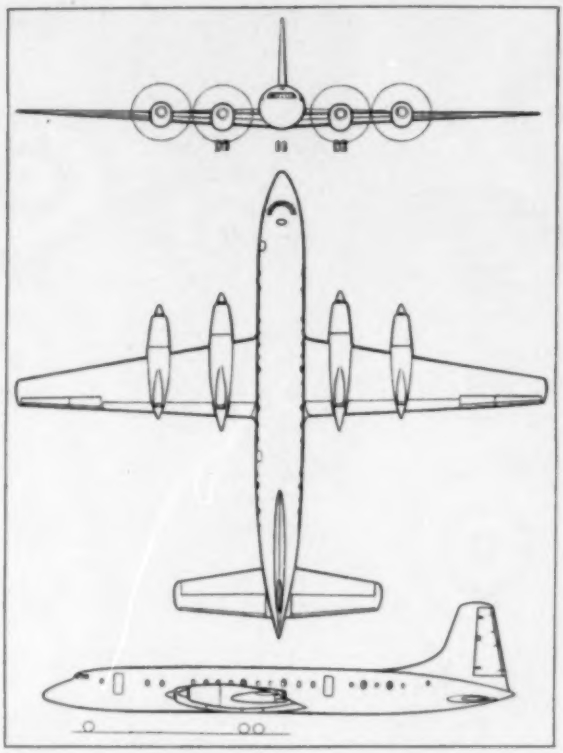
Now under construction at Filton are three later Britannias which already appear on the British civil register: G-AMYK (the prototype 200); G-AMYL (Series 300); and G-ANGK (Series 250). All these aircraft are the forerunners of the long-fuselage, more powerful range of Britannias which the Bristol Aeroplane Company and Short Brothers and Harland are preparing to make for large-scale export during the next decade. These aircraft will be powered by the Proteus 755, of about 4,150 e.s.h.p., which can already be considered exceptionally well developed for an engine not yet in service. The basic details of these later Britannias were published in our issue of August 13th, 1954.

Among other improvements will be a possible increase in internal fuel capacity to 8,300 Imp. gal, which will suffice to make the aircraft so fitted (designated Britannia 300 L.R. or 250 L.R.) capable of operating non-stop London-New York services for at least 95 per cent of the year, while carrying a full passenger load of from 65 to 101 according to the class of service offered. The 300 should cruise at more than 350 m.p.h.

The key to a good transport is its engine. The Proteus seems certain to be the first large turboprop to go into regular commercial service, and it should very soon achieve an overhaul time approach-



These "Flight" copyright drawings show the Douglas DC-7D (left) and the Bristol Britannia 300 (right) to the same scale. Their basic data are: DC-7D, span, 127ft 6in; length, 112ft 3in; all-up weight, about 150,000 lb. Britannia 300, span, 142ft 3in; length, 124ft 3in; all-up weight, about 165,000 lb.



LONG-RANGE BATTLE . . .

ing 1,000 hours—in fact, the figure should be well up in this region before scheduled services are actually begun. On the scores of weight, specific consumption and installed drag, the Proteus, although obviously better than anything that has gone before, is naturally not to be compared with design thought today. In fact its successor, to which reference is made below, is now almost ready for running. The only fair way to assess an engine is to compare it with its contemporaries. Many people today mislead themselves—and others—by confusing the time factor.

Nevertheless, the pace of gas turbine development has been very rapid since the Proteus was designed. About 1951 it was decided that a new Bristol turboprop should be developed, and the following features were selected: two-spool axial compressor with a pressure ratio of about 11 : 1; straight-through (i.e., not reverse flow) combustion chamber; and a multi-stage turbine, one stage driving the h.p. compressor and three stages driving the l.p. assembly and its attached airscrew reduction gear-box.

The development of the reduction gear and airscrew is, in the experience of British manufacturers at least, one of the most difficult parts in the preparation of a turboprop power unit. In the Britannia installation a very efficient de Havilland airscrew is matched with an excellent double-helical reduction gear which has already successfully completed the most arduous testing. It was soon realized that it would pay handsomely to retain an airscrew and reduction gear very similar to those already developed, and couple them to the new engine. On the other hand, it was obvious that the new gas turbine would be able to give far more power than had the Proteus, although it would be no larger.

The result of these factors is the Bristol BE.25, which promises to be a very valuable engine indeed. Basically it is capable of delivering 8,000 h.p. at sea level, but 4,000 h.p. is about all that the Britannia can manage, and this is the power to which the BE.25 is throttled. As a result the engine is smaller and lighter than it would be if full power were permitted, and it utilizes a reduction gear and airscrew very like that now used by the Proteus. Further, as it is not at full throttle at sea level the power does not diminish with increasing altitude; in fact, the full 4,000 h.p. is still available at 20,000ft. Consequently, any aircraft powered by the BE.25 need never worry about airfield height or temperature.

The BE.25 is reported by an American journal to be rapidly approaching the stage at which complete engines will be running on the test stand. One cannot fail to draw a comparison with the Rolls-Royce RB.109, which is reported to be in a very similar stage of development. The RB.109 is likewise a two-spool engine of high efficiency, but it is—like all other gas turbines apart from the BE.25—a full-throttle engine, i.e., its sea-level power of 4,000 s.h.p. falls away as soon as altitude is gained. It may be expected, therefore, that it will be smaller and lighter than the BE.25; on the other hand, it will not be able to match the Bristol engine in the matter of high-altitude cruising power.

The BE.25 has, according to American reports, been so designed that it can fairly readily be fitted into the Britannia. In fact, it is hoped that this will be possible during a normal airline major overhaul. It is probable that this conversion will take the Britannia up to an airframe limit of about 300 knots I.A.S. Such a re-engined Britannia would be attractive, but Bristols are, naturally enough, preparing a completely new transport with four BE.25s specified from the start. It is too early to discuss such a machine, but it should at least match the speed of present jet transports, and with unrivalled economy.

It may, therefore, seem strange that B.O.A.C. should express an interest in the derivatives of the Douglas DC-7. As we have stated above, no airline can afford mistakes when it comes to transports of this calibre, and the British Corporation's interest in the projected DC-7D stems from a sensible desire to study "insurance alternatives." On the face of things it does appear that any DC-7 development could match any Britannia with which it might be contemporary, but these new Douglases are worth studying.

The DC-7C has already been discussed, and is on order by such operators as South African Airways and S.A.S. It has a wing with an extended centre-section, and houses over 8,000 gallons of fuel. The DC-7D is a further development re-engineered to take four of the Rolls-Royce RB.109s mentioned above. As the general-arrangement drawings show, it should be an attractive aircraft, and its development should be considerably facilitated by the Douglas company's vast experience in "beefing and stretching" sound basic designs. Its development will, however, raise new problems. The weight of the DC-7 is already such that a bogie undercarriage is desirable, and the optimum slim nacelles behind the RB.109s will not house large wheels.

Compared with the basic Britannia 300—with which it must be matched (in fact the 300 should be on the routes considerably earlier)—the turboprop Douglas promises to be faster, cruising at up to 390 m.p.h. On the other hand it will not be able to match the Britannia's range/payload curve at any point and, from the airline point of view, will probably prove less flexible in service. For example, the Britannia has a fuselage 12ft in diameter, which permits six-abreast seating.

Time alone will tell how these two lines of development will show up in direct competition. Present indications are, however, that, if all goes well, Bristol's will have a family of transports which will not be matched until the 1960s at the earliest.

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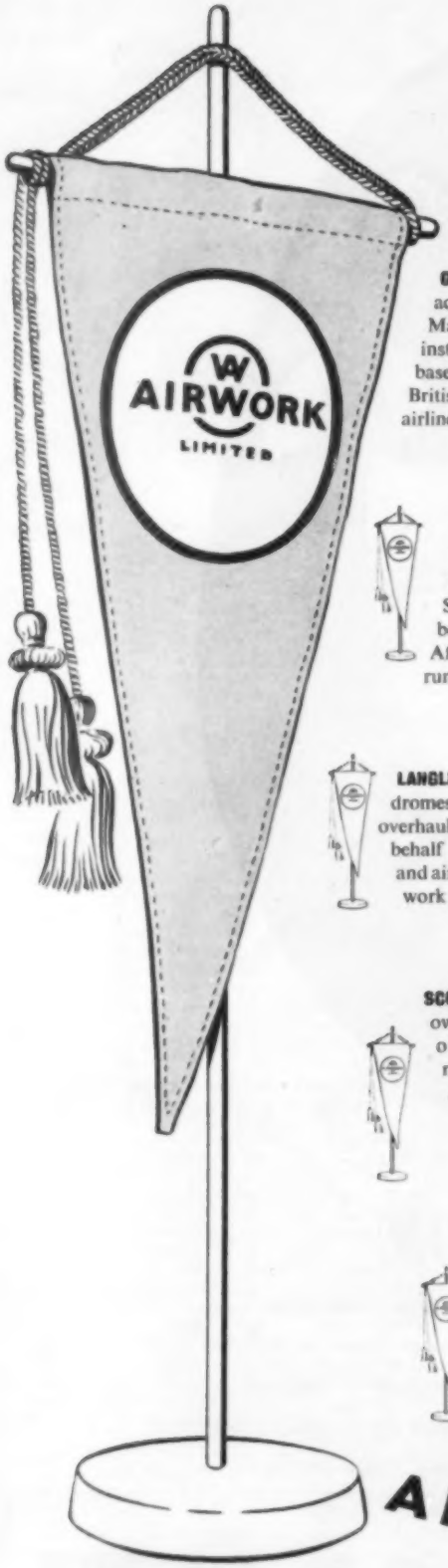
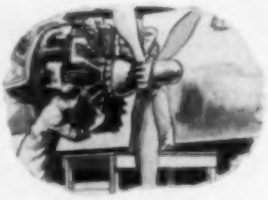


ASPECTS OF AIRWORK . . .

GATWICK Among the many important Airwork activities at Gatwick is the Company's Repair and Maintenance Division, whose work includes prototype installations. The Airwork Radio Department is also based there. Many contracts are undertaken for British and foreign governments and also for private airline operators.

BLACKBUSHE, home base for Airwork's passenger operations, is, in addition, an Airwork aircraft servicing centre. It is also the U.K. terminal for the successful Safari Services jointly operated by Airwork between the U.K. and East, West and Central Africa. This is the first public airline to be run by private enterprise since pre-war days.

LANGLEY Langley is another of the aerodromes at which Airwork undertakes repair, overhaul and conversion of aircraft on behalf of leading aircraft manufacturers and airlines. Experimental and development work is also carried out here.



SCONE This aerodrome near Perth is owned by Airwork. Here the Company organises flying, engineering and navigational training on behalf of the Admiralty and the Air Ministry, including the conversion training of all naval pilots to heavy twin-engined aircraft. Scone is also one of the aerodromes at which Airwork carries out radio overhaul work.

SPEKE The comprehensive repair, maintenance and development work undertaken by Airwork at this Liverpool aerodrome includes the erection, modification and servicing of Sabre jet aircraft operated by R.C.A.F. Fighter Squadron from U.K. bases.

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UNFASHIONABLE D/F.

A Plea for its Restoration as a Safety Aid

By GONIO

A RECENT article* in which a transport pilot recalled experiences in encounters with turbulence in certain cloud conditions contained statements which cause one to wonder whether modern aviation, in seeking new (and, presumably, better) radio aids to safety and navigation, has not discarded older methods a little too quickly. Four extracts from the article will serve to establish the basis for this query:—

"During the war in the Far East, at least 19 aircraft—mostly Dakotas . . .—broke up in cu-nim; and the number of unexplained losses was probably higher."

". . . After about fifteen minutes—during which time all I could manage to do was to keep the aircraft right side up, and within 90 deg of course. . . ."

". . . Meanwhile, with two of us fighting the controls—feet on the instrument panel at times—and with engines on full power we lost height to 4,000ft, the altimeter unwinding madly. . . . Then without time to breathe, we went up—throttles fully closed, altimeter winding up, rate-of-climb stuck at 4,000 ft/min—until we were thrown out of the top (or perhaps the side) of the cu-nim at 19,500ft . . . Eventually, with A.S.I. unserviceable, and both compasses about 30 deg wrong, owing to the alteration in magnetism, we made St. Mawgan by homing on the radio range, two hours overdue."

"We are informed by meteorological experts that hailstones of 4½in diameter have fallen in Northern Rhodesia. The calculated vertical current required to sustain a hailstone of this size during its formation is apparently, one of about 200 m.p.h. . . . an aircraft cruising at 100 m.p.h. and meeting such a current would be subjected to about 5 or 6 g; or, cruising at 200 m.p.h., about 19 g—the g increasing as the square of the speed."

As a radio man with quite a few years' experience in working aircraft from the ground I tried to put myself in the position of an aircraft radio officer encountering such conditions and finding a situation of imminent danger developing.

Considering the third and fourth extracts above it would seem that both first and second pilots would be far too busy fighting the aircraft to be able to attend to R/T. transmissions; the onus of sending the distress message, therefore, would fall on the radio officer. No one could be expected to send readable morse whilst alternatively ascending and descending at 4,000 ft/min, and the imagination boggles at the thought of R/T. when one's stomach is being assailed in such a fashion. The only hope of getting a signal through under such conditions would be by the use of some sort of automatic transmitter.

But getting the distress call through would be only half the job. Under present conditions, with the withdrawal of long range D/F. facilities, it is the responsibility of the aircraft captain to tell the ground organization where he is. Unless the aircraft were fitted with a type of equipment that presents a continuous record of position the possibility of obtaining a current position plot would seem to be extremely unlikely in the circumstances described. No method involving instrument manipulation or calculation would appear possible; and one wonders whether tracking equipment would stand up to the violent alterations of course and height and the general buffeting to which it would be subject.

Turning to the consideration of D/F., many will recall the drill laid down for emergency operation. The distress call was sent and, if the situation was such that further manual transmission became impossible, the key was screwed, all further operations being in the hands of the ground organization. Any unusual signal was D/F.-d as a normal precaution so that if an alert were raised such intercepted signals could be plotted. With the present congestion of frequencies and the distances involved it is probable that coverage by M.F. D/F. would not be economical; but surely an H.F. fix with a "cocked hat" of a hundred-mile side would be preferable to the almost unrestricted field of search presented on the disappearance of a modern high-speed aircraft when that aircraft has been flying on an unknown course for even a moderate time.

It is significant that the R.A.F. still maintain a D/F. organization, though it is admitted that the service must plan for the needs of aircraft which have been involved in enemy action and have a minimum of equipment in operation. The point arises: when are civilian passengers and aircrew considered to be expendable? A decision not to provide *all* available safety measures tacitly implies a limit beyond which losses are acceptable. It seems that the prime advantage of D/F., that of providing the ground organization with an independent means of assessing an aircraft's position is not met by any of the new systems, and that, until a 100 per cent method of avoiding conditions of cu-nim is put into general use, the planning authorities are rather in the position of placing all their eggs in a basket that might at times be subject to disastrous upheaval.

Considering the situation as it affects the ground control organization, it is quite obvious that this department must exercise its functions mainly on second-hand information. When compiling instructions for aircraft A in relation to aircraft B, Control must accept B's estimate of its position without having recourse to any independent check. Therefore the safety of A may depend to an appreciable extent on the accuracy of B's position-plotting and communication with Control. Without wishing to detract one iota from the known high standard of navigation employed by present-day crews it is difficult to see how Control can exert a positive function as distinct from an informative service when the sources of information are so removed from positive and independent check.

It will be appreciated that in the foregoing the position is considered primarily in relation to circumstances where aircraft routes cross wide stretches of water or of sparsely inhabited land. In these conditions a few strategically placed D/F. stations would provide a checking system, perhaps not of pin-point accuracy but of sufficient usefulness to warrant the comparatively modest outlay incurred. This would ensure that, while an aircraft's main transmitter and receiver (possibly the most robust radio equipment on board) are functioning, a useful navigational service would be available both to the aircraft and to ground control staff.

With a modern transmitter having several crystal-controlled "spot" frequencies, one or two could be assigned as route distress frequencies, the selection being made with due regard to propagational characteristics obtaining over the route. A single switching arrangement would bring one or both of the frequencies into operation together, with an auto-sender which would cause the distress signal to be transmitted without further attention by the crew.

For routine checks the main control point would exercise organizing authority and ground/air communication be maintained on the normal frequency. This installation would give Control the confidence of having a check on the information he was using and sustain the aircraft operator with the knowledge that in a dire emergency the use of a single switch would give the passengers and crew some sort of chance of being found and rescued before they were written off as another regrettable total loss.

One suspects that D/F. is regarded in some quarters as being rather prehistoric, and I hasten to assure the sceptics that I have a profound admiration for the ingenuity shown in the design of modern radio navigational aids. Nevertheless, we must remember that radio's main function in the aeronautical world is to assist in promoting safety as well as good navigation. There will be more joy over the finding of the one that strayed than over the ninety and nine that kept to the straight and narrow path and arrived on time.

So, to mix our metaphors quite thoroughly, let us not throw away the fire-bucket before we are quite sure that the thermal-controlled sprinkler system will answer all emergencies.

*"Turbulence in Cu-nim," by W. M. Anderson. "Flight," May 28th, 1954.

FIFTY YEARS OF THERMIONIC VALVES

TUESDAY, November 16th, marks the 50th anniversary of the patenting by Sir Ambrose Fleming of the thermionic valve. It was while working as scientific adviser to Marconi's Wireless Telegraph Co., Ltd., in 1904, that Sir Ambrose, in his search for better means of detecting electro-magnetic or wireless waves, produced the oscillation valve. It was this device, originally constructed in one of the old experimental bulbs in which he had been testing the passage of electric currents through rarefied gases which, by 1913, had been developed into the basic triode valve for detecting, amplifying and generating high-frequency oscillations. Although it was possible to do these things by other means, the thermionic valve was the simplest, most reliable and commercially feasible means of doing so, and in its various developments it has formed the basis of wireless, long-distance land-line telephony, television, D.F., navigation aids, aircraft control and landing systems, radar, electronic brains, and finally guided missiles, to quote but a few of its applications.

The striking upper gull-wing of the Central-Lamson machine contributes to its unusual appearance. Here the Air Tractor makes a run over an orchard.

AIR TRACTOR

Details of a Specially Designed American Agricultural Aircraft

WHILE existing types of conventional trainers and other light aircraft are in use in large numbers for agricultural work, the need for a specialized machine has recently been widely publicized. Two qualities needed in any such machine, which would need to be specifically designed for its job, would be good slow-speed flying characteristics and good visibility. One approach to this is the "Air Tractor," a unique machine designed by Bob Lamson, a former test pilot of the Boeing Airplane Company, specifically for the dusting and spraying of crops with insecticides.

The Air Tractor is a curious, antiquated-looking aeroplane, having no resemblance to any other in the aircraft industry, but, since the prototype was first flight-tested in December 1953 it has aroused a great amount of favourable interest among crop-dusters throughout the United States and in many other countries, especially in Australia and New Zealand. Distinctive features of the machine resulted from more than a decade of experience gained by Central Aircraft, of Yakima, Washington State, which specializes in "aerial farming," plus suggestions from scores of crop-dusting operators, and co-operation in design and construction by the Lamson Aircraft Company. These two companies formed a third one named Central-Lamson Corporation in order to manufacture the aircraft, for which Central Aircraft acts as sales agent.

The photographs on this page are of the prototype aircraft, which was undergoing a series of operational tests last August with airscrews of various blade configurations. Two new models of the machine were to be flight-tested in September and go into commercial production in November. They do not differ basically from the prototype. It is highly probable that the first of these will be sold to New Zealand.

Figures obtained from operations are stated to indicate that the operating cost of chemical application per area covered will be only 55 per cent as much with the Central-Lamson plane as with the best existing aircraft converted for the purpose. One reason for this is that heavy downwash of air from the wings distributes in a more effective manner the dust or spray among thick ground crops and in orchards.

Unconventional features of the aircraft, which is the first to be designed and built solely for agricultural work, are of interest. The fuselage frame is made of welded steel tubing, covered in the forward portion but left open in the rear section for easy inspection, checking of control-linkage, and cleaning of the frame members after use of corrosive spray or dust chemicals. The wing spars and ribs are of wood, covered with fabric, to simplify maintenance and repair in the field of operations. The gull-wing shape of the upper wing gives the pilot unobstructed forward visibility of the ground while dusting. All four wing units are identical in shape and size, have fittings on each end, and are interchangeable with one another and with a spare wing. They have a high-lift aerofoil section and spill-plates on the tips to increase lift and ensure uniform distribution of insecticides. The wood and fabric ailerons have a combined area of 44 sq ft, and the total area of the wings is 350 sq ft. There are no flaps.

The tail unit consists of steel-tube frames covered with fabric. The fin, rudder and elevators are, like the wings, of identical shape and size, and so are interchangeable. Special hinges attached to them make incorrect installation impossible. The four units have a combined area of 50 sq ft. The fixed tailplane has a 13ft span and area of 25.6 sq ft.

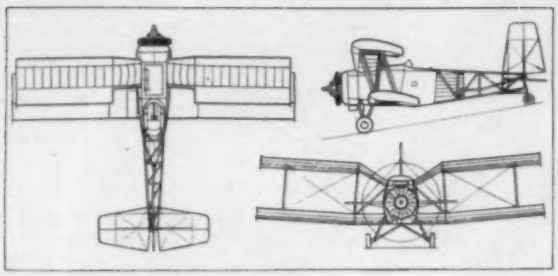
The undercarriage is of conventional non-retractable type. It consists of a pair of mainwheels, mounted on shock-absorber struts and equipped with disc-type brakes, and a steerable tailwheel. The wide front-wheel track (88in) provides good stability on the ground.

The Air Tractor is powered at present by a 450 h.p. Pratt and Whitney Wasp Junior engine, fitted with a Hamilton Standard airscrew, but other types of engines and airscrews may be used later. In particular, future plans call for a somewhat smaller version of the machine, using a less powerful engine.

Fuel tanks installed in the roots of the upper wing have a capacity of 50 U.S. gallons, and the feed to the engine is by gravity, while the oil capacity is 10 gallons. Flight instruments are mounted on the rear edge of the gull-wing roots where they are on a level with the pilot's line of vision, so that he does not need to look into the cockpit when flying less than 5ft above ground.

Complete equipment for dusting of spraying, or both, includes a

A view forward over the cockpit. Fuel tanks are housed in the gull wing roots, on the rear edge of which the flight instruments are mounted.



LAMSON AIR TRACTOR

Dimensions

Span	35ft 7in
Length	26ft 5in
Height	10ft 8in
Weight (empty)	3,200 lb
„ (loaded)	5,600 lb

Performance

Cruising speed	100 m.p.h.
Minimum flying speed	35 m.p.h.
Take-off run (2,500 lb load)	990ft
Rate of climb „ „	450ft/min
Landing run „ „	950ft
Take-off run (1,500 lb load)	410ft
Rate of climb „ „	950ft/min
Landing run „ „	390ft

(Field altitude, 1,070ft; air temperature, 50 deg F.)

hopper or tank of 360 gal capacity, a pump, agitator, booms, dispensing nozzles, and throat and dust controls. Different models are available, however, at prices round about $15,000 (approximately £5,350), fully equipped.

Central Aircraft is one of the leaders among crop-dusting and spraying operators in the United States, who are at present using more than 7,000 conventional-type small aircraft in campaigns to reduce crop damage and increase yields of wheat, cotton, fruit, timber and many other agricultural products. Since the company bought its first small aircraft for agricultural use in 1934, it has increased its fleet to thirty, and now does more than 120 distinct types of aerial application on scores of different crops and timber trees in all parts of the United States and Canada.

A variation from insecticide application is the seeding of rice on huge rice fields in California, and, more recently, the company has developed a practical and successful method of sowing wheat. It is working also on experimental programmes for killing under-

The Central-Lamson Air Tractor, approaching to land and on the ground. The structure is essentially simple, and the rear fuselage is an open framework.

growth brush on fir-tree farms and brush on cattle ranges in the south-western states, and for applying fertilizer on timber lands.

The company is the only one in the industry that operates a school for training pilots, from the U.S.A. and abroad, in this type of work. The school's primary purpose is to assure a continued supply of trained, responsible pilots for operation of the company's aircraft and those of its sub-contractors.

SOVIET HIGH-LATITUDES EXPEDITION

IN the spring of this year the Soviet Union launched a large-scale "High Latitudes Flying Expedition" for scientific and exploratory investigations in the Northern Ice Ocean, near the North Pole. Its aerial backing is of considerable interest, following, as it does, on a previous successful North Pole expedition in 1937, under Schmidt and Papanin. (The former expedition relied mainly on four ANT-6 transports.)

Since pre-war days, when small groups of scientists remained for some months on ice-floes in Arctic waters, Russian interest has been centred on the drift of the ice; thus, an expedition of 1950 was based around a floating North Pole station called SP-2. In April this year two more North Pole stations were set up; they are SP-3, under the command of Hero of Socialist Labour A. F. Treshnikov, an oceanographer, and SP-4—under meteorologist Ye. I. Tolstikov. Between April and July 15th these stations had drifted 300-400 km nearer the North Pole, having been established at the 180th meridian, SP-3 at about 86 deg North and SP-4 about 75 deg North.

Aeronautical interest centres on the use of an Il-12 twin-engined transport as the "headquarters command post" of the expedition. This machine, apparently, is operating under the ultimate direction of Glavsevmorput—"Chief Administration of the Northern Sea Route," responsible for opening up the coasts and seas at the northern edge of Siberia. (The aerial detachments of Glavsevmorput were at one time known as Aviaarktika, but is now seems that the name has been changed—or, less likely, a new organization formed—as the Li-2s, at least, which are working with the 1954 expedition bear the name and crest of Polarnaya Aviatsiya—"Polar Aviation."

Aerial support is based on Dikson Island, whence the expedition set out. The scientists and staff who permanently inhabit the stations SP-3 and SP-4 have been supplied with all their equipment by air. They have inflatable tents, radio and much scientific equipment, and even light trucks, of the GAZ-69 type. The hard ice of the floes acts as a perfectly satisfactory landing ground for even very heavy aircraft. The Il-12s are no lightweights, and even the Li-2s, fitted with skis and cold-weather shutters to their cowlings, must exert considerable stresses on the ice. However, the most unusual—and largest—type employed is a "civilianized" PE-8. This four-engined bomber of World War II was relegated to a transport role some years ago, and it is interesting to learn that some are still in service. Reconnaissance and liaison flights fall to the lot of LAR-3 helicopters and an AN-2 biplane, which has been equipped with skis.

This 1954 expedition will not only provide much new information about ocean and land conditions and geography near the North Pole, but should also yield additional data on the problems of operating aircraft in these regions of very low temperatures.

SAUNDERS-ROE APPRENTICE SUCCESSES

SUCCESSES achieved by apprentices of the Saunders-Roe School during 1954 include two B.Sc.(Eng.) degrees, at Southampton and London Universities respectively; two B.Sc.(Eng.), Part 1, at London and Southampton Universities; ten passes out of 21 entries for the Ordinary National Certificate in Mechanical Engineering (with special reference to Aeronautics), including passes with distinction for Applied Mathematics, Applied Mechanics and Aeronautics; two out of four passes in the O.N.C. in Mechanical Engineering (General); three out of five passes for the O.N.C. in Electrical Engineering; and four passes, three with Distinction, out of four entries for the Higher National Certificate in Mechanical Engineering (with special reference to Aeronautics); of these last, one was a National Certificate Prize-winner. In addition, 51 other apprentices entered for various examinations, and of these 39 passed.

Now in production at Dallas, Texas, is the Chance Vought F7U-3P photo-reconnaissance version of the Cutlass. It is referred to below.

AIRCRAFT INTELLIGENCE

U.S.A.

Chance Vought F7U-3P. Illustrated on this page, the F7U-3P is the photographic-reconnaissance version of the F7U-3 Cutlass fighter of the U.S. Navy. To accommodate five camera stations the nose has been lengthened by 25in. A nose camera shoots forwards and downwards; a second camera, centrally mounted, can photograph straight down, or obliquely at 45 deg; and in the rear station is provision for a trimetrigon installation of three cameras. By changing the type of camera the aircraft can be adapted for four different duties—general reconnaissance, mapping and charting, "beach and off-shore," and night reconnaissance. (For the last-named duty it will carry 104 flash bombs in what normally serves as the gun bay.) The pilot has a viewfinder, which provides him with forward or vertical views, projected on a lens mounted on the top of his instrument panel. He is able to position the general reconnaissance cameras as required, set the interval controller and adjust the film speed on the beach reconnaissance camera. Normal operation is automatic, but the pilot may make individual exposures. A special feature is a "camera azimuth mount" which, in case of a crosswind, aligns the camera with the true flight path of the aircraft. This is remotely controlled from the cockpit.

Northrop F-89 Scorpion. Although Scorpion fighters, as very extensively used by the U.S.A.F., have been flown consistently above 52,000ft, the type has not yet attained its aerodynamic ceiling, and the makers plan to increase power to get the Scorpion higher and to afford greater manoeuvrability at the higher levels.

Republic F-84F Production. Full production of the Republic F-84F jet fighter is to be resumed at Farmingdale, Long Island, where 700-1,000 of the 6,000 workers were recently laid off because of an over-accumulation of completed airframes while awaiting modifications. Plans have now been made to take care of the modifications and to resume full production, which, the U.S. Assistant Secretary of the Air Force has said, he is anxious to see by the end of this year.

France

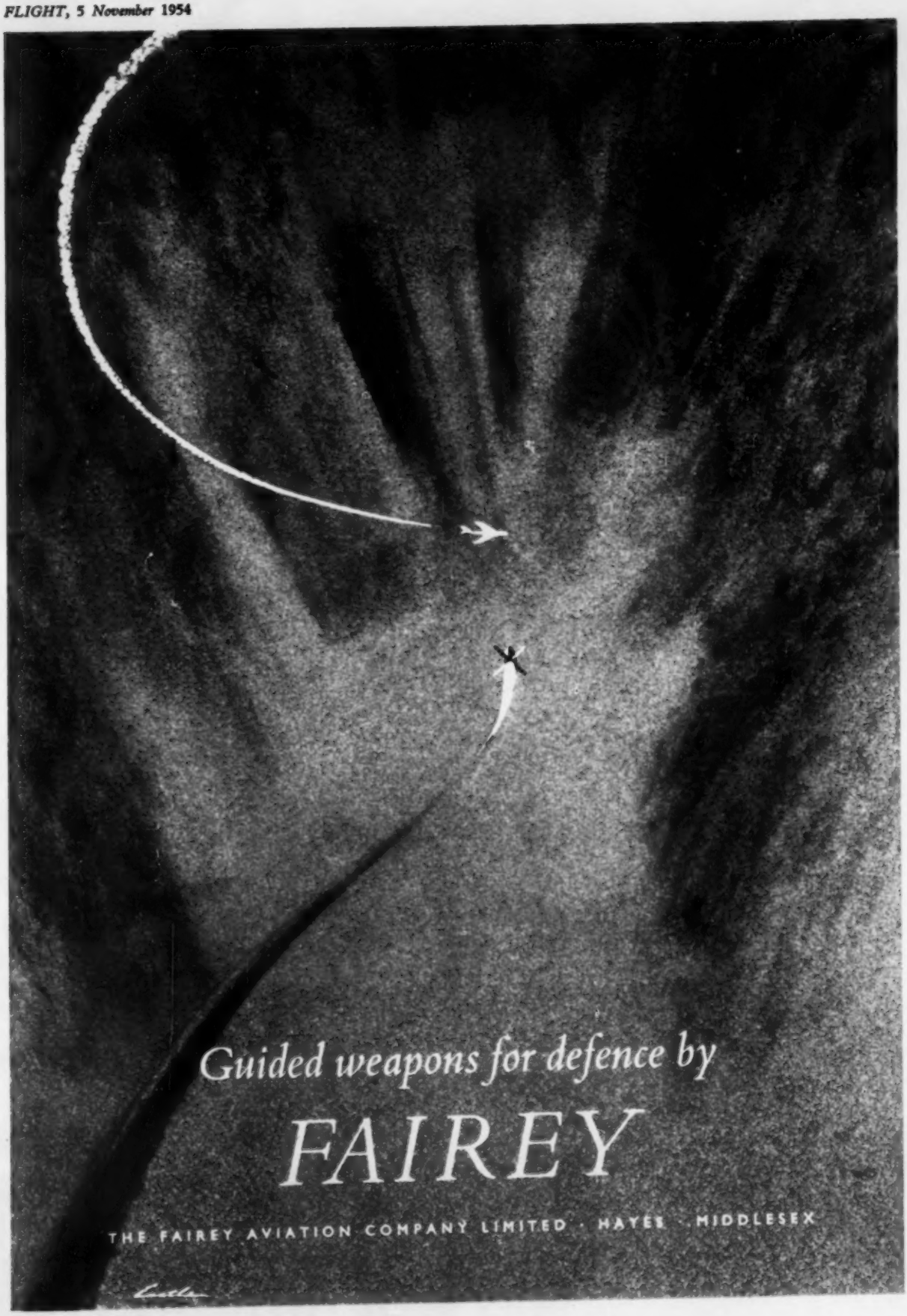
S.O. Light Intercepter. Construction of a light intercepter fighter, based on the design of the Trident rocket-*cum*-turbojet straight-winged research aircraft, has reached an advanced stage. This machine will fly at high supersonic speeds at extreme altitudes. Meanwhile, tests with the Trident go forward, and a number of flights have been made with rocket power, using the wing-mounted Turbomèca jets as auxiliaries. The first of these flights was on September 4th.

NATO

Light Fighter/Attack Competition. Unofficial reports that the Folland Gnat is leading in the lightweight fighter/attack competition organized by NATO are quoted by *Aviation Week*, who add that the British aircraft is followed by the Dassault Mystère 26 and the Fiat GA-91 (Bristol Orpheus). The Gnat's lead is credited to the demonstrations by the Midge prototype at the S.B.A.C. Display this year. Other designs being submitted for the competition are an Avro delta, the Breguet 1002 Taon (designed for two Vipers or two Turbomècas), a modification of the S.N.C.A.S.O. Trident, the S.N.C.A.S.E. Durandal (Atar), and the S.F.E.C.M.A.S. 1402 Gerfaut, likewise Atar-powered. All French designs except the Taon (and probably the Trident development) are deltas.

LOCKHEED YC-130
(Four 3,750 h.p. Allison T56-A-1 turboprops)

Span	132ft
Length	95ft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Forerunner of the KC-135 tanker for the U.S.A.F. is the Boeing 707 experimental jet transport, seen on the right near Mount Rainier. Below is a model of the Vickers 1000, already ordered into quantity production for R.A.F. Transport Command. At the foot of the page is the most advanced military trooper/freighter in the air today—Lockheed's turboprop-powered YC-130 (See also G.A. drawing on page 676).

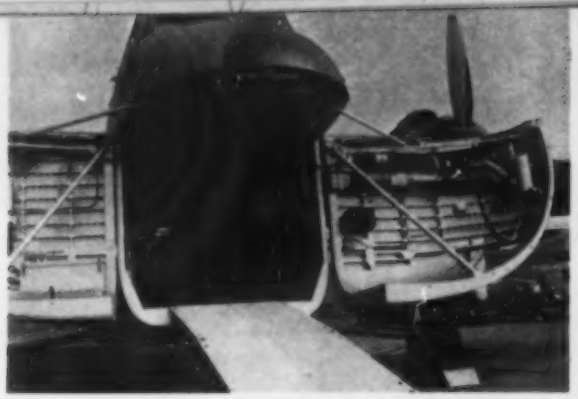
MILITARY TRANSPORTS

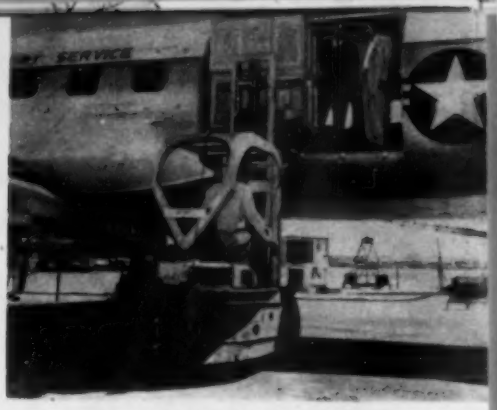
Some Aspects of Current and Future Types

SELECTED here for appraisal from the ever-broadening field of military air transport are those medium and large fixed-wing aircraft upon which must devolve for a period of years the tasks of troop- and freight-carrying, air supply, assault, and medium- and long-range casualty evacuation. It is, of course, already clear that the helicopter and convertiplane must shoulder an increasing share of the Army's load, and their omission from these pages implies no underestimate of their current usefulness or future potential.

Within the prescribed field, then, the so-called "strategic," or, more explicitly, long-range, transports command immediate attention.

In the Royal Air Force the standard type is the Handley Page Hastings C.2, with four Bristol Hercules 106 engines. All-up weight is 80,000 lb, of which 23,300 lb can be payload; for a 3,000-mile range, however, the figure is 10,000 lb. Normal cruising speed is considerably less than the maximum weak-mixture speed of 302 m.p.h. Provision is made for 30





(Left) Nose-loading doors of a Bristol Type 170 Freighter. (Right) Loading a Convair C-131A by means of a lift truck.

Douglas C-124B Globemaster.

Lockheed R7V-2 Super Constellation.

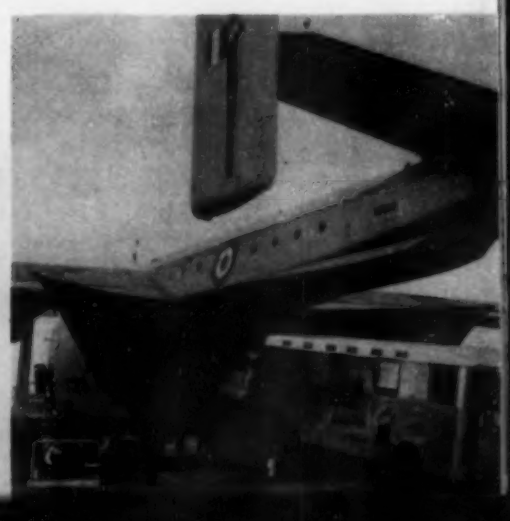
(Above) The 500th Boeing C-97 (actually a KC-97G).
(Below) Douglas R6D-1 (The U.S. Navy's DC-6A).

MILITARY TRANSPORTS . . .

paratroops, with supplies, 32 stretchers plus 28 sitting wounded, or 50 fully equipped troops. The freight loading door, admitting such items as jeeps and field guns, is on the port side and incorporates a paratroop door, which is duplicated on the starboard side.

Of American counterparts the Douglas C-54 Skymaster (designated R5D by the U.S. Navy) is the oldest. Well over a thousand of these machines (Pratt and Whitney R-2000 engines) were built, and late models carry some 16,500 lb of cargo for 1,450 miles at 220 m.p.h. The DC-6A serves with the U.S.A.F. and U.S. Navy respectively as the C-118A and R6D-1 and by virtue of higher speed, greater payload and longer range, one of these machines is capable of doing the work of two C-54s (cruising speed is about 40 per cent higher at the same cabin altitude and payload capacity some 10,000 lb greater); furthermore, the C-118A carries its capacity payload for 1,900 miles as compared with the 1,450-mile range of the C-54 with its own maximum load. With the same payload as the C-54 the C-118A has a range of 2,760 miles. Sixty passengers can be accommodated in rearward-facing seats, or 76 on troop benches, and in the "cas. evac." role the C-118A will take 40 stretcher patients. Two very large, hydraulically raised cargo doors give access to the cabin, which is of 5,000 cu ft capacity. Like their airline counterparts, the C-118As and R6D-1s have automatically controlled cabin pressurizing and air-conditioning systems. Cloud-warning radar is standard equipment.

Another major contributor to the strategic transport forces of the U.S.A.F. and Navy is the Lockheed concern, which has in service the C-121A (military version of the Model 749 Constellation), the C-121C (Model 1049B Super Constellation equivalent), and the R7V-1 (U.S. Navy version of the 1049B). For the R7V-1 the claim that it is the fastest military transport in service can certainly be substantiated, for the Wright R-3350 Turbo-Compound engines confer cruising speeds of up to 335 m.p.h. As a freighter it will take a

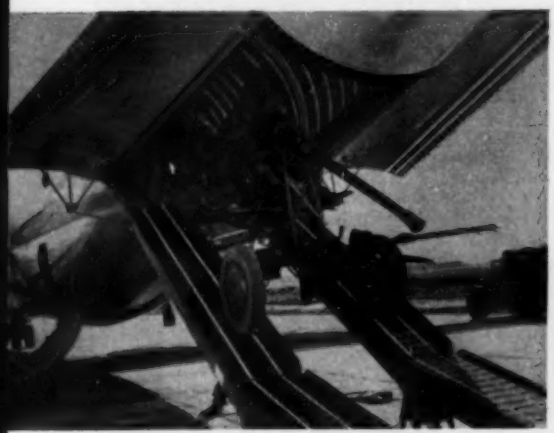


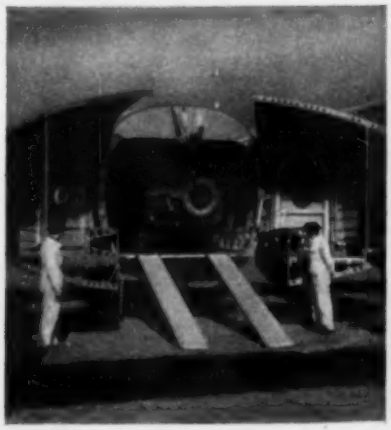
(Left) Illustrative of the bow loading arrangements on the Convair R3Y-2 Tradewind flying boat. (Right) A five-jeep load from a Chase XC-123.

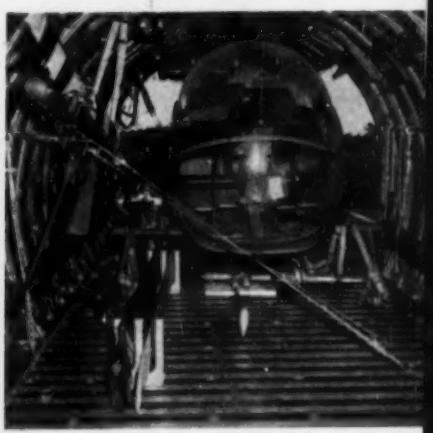
load of up to 19 tons; in the personnel transport role it seats 106 passengers; and for casualty evacuation it takes 73 stretcher cases. No specific payload/range combinations have been announced for this aircraft, but it should be capable of lifting 30,000 lb for 2,500 miles, with allowances.

The military counterpart of the Boeing Stratocruiser is the C-97 Stratofreighter, to which the attention of readers has been drawn in recent weeks by the announcement that over 500 have already been built, and by an article describing a visit to a KC-97 squadron in our issue of October 8th. All Service-type aircraft of the C-97 family are powered with Pratt and Whitney R-4360 engines. The C-97A was the first production model, with a normal payload of over 41,000 lb and capable of carrying 134 fully equipped troops or 83 stretcher patients; the next version built in quantity was the C-97C, capable of carrying (by virtue of a heavier floor) a greater payload, and later came the KC-97E multi-purpose transport and tanker, with its special detachable "pod" housing boom-refuelling equipment and operator. The "F" was similar, but the present KC-97G (of which 20 are attached to each 45-aircraft

(Left) A wing of a Fairchild Packet loaded for shipment in an aircraft of the same type. (Right) An AMX tank going aboard the Breguet 763 Deux Ponts.

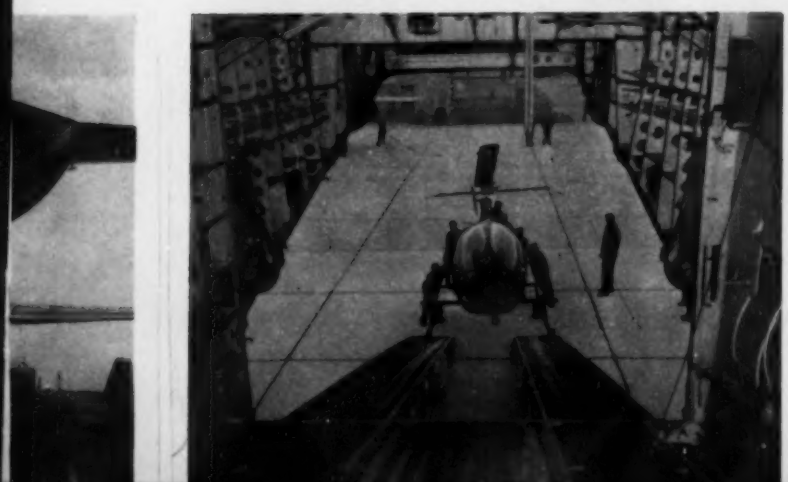






(Above, left) Loading a 40 mm Bofors gun on to a Boeing C-97 Stratofreighter. (Centre) Rear-loading arrangements on the Nord 2501 Noratlas. (Right) A Bell H-13 helicopter stowed on the upper deck of a Boeing C-97.

(Below, left) A plastic pipe-making unit is a possible load for the Blackburn Beverley. (Centre) A Bell H-13 helicopter comes aboard a Douglas C-124C. (Right) The pressurized cabin of the Boeing C-97 is a welcome amenity in casualty evacuation work.



A Fairchild C-119 of the 314th Troop Carrier Group, U.S.A.F., approaches over imperturbable Japanese labourers.

MILITARY TRANSPORTS . . .

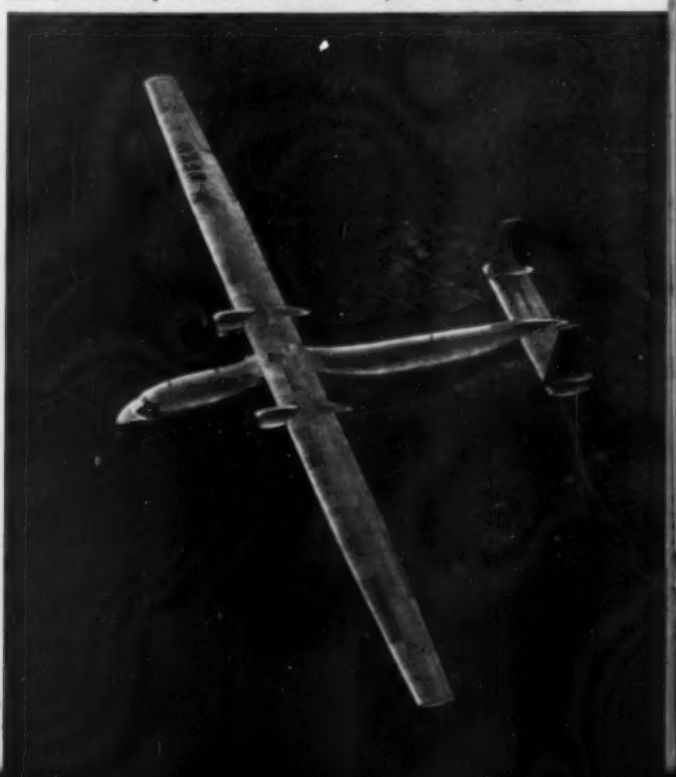
B-47 Wing) is so arranged that the refuelling equipment need not be removed when the aircraft is used solely for transport. All variants are quickly convertible for various duties; thus, a C-97 fitted for carrying lorries and guns can be converted for freighting in 1 hr. For casualty evacuation, with 79 stretchers, conversion takes 5 hr; for the transport of 130 fully equipped troops, 4 hr; and for air-dropping of troops or cargo, 3 hr. Cruising speeds approaching 300 m.p.h. are attained in service, and the maximum range is 3,750 miles. Gross weight of the "G" is 175,000 lb.

The transports so far considered have been developments of, or parallel developments with, civil designs. There is, however, one type in extensive service which is wholly military in concept and which has greater capacity and far more effective loading arrangements. This is the Douglas C-124 Globemaster II, with Pratt and Whitney R-4360 engines. Normal gross weight is 175,000 lb, and a load of up to 50,000 lb can be carried for 1,000 miles, with fuel remaining for return to base. The claim is made that the Globemaster II can handle 94 per cent of all U.S. military vehicles, and that at present only a fleet of these machines can transport by air an entire infantry division, including millions of pounds of equipment required for its support. In service the Globemaster II has greatly exceeded its designed carrying capacity by taking off at a weight of 194,000 lb, at which loading a 50,000 lb payload can be carried for a range greater than 2,500 miles, with reserves. Maximum payload for short ranges is over 70,000 lb, and cubic capacity for cargo stowage totals about 10,000 cu. ft.

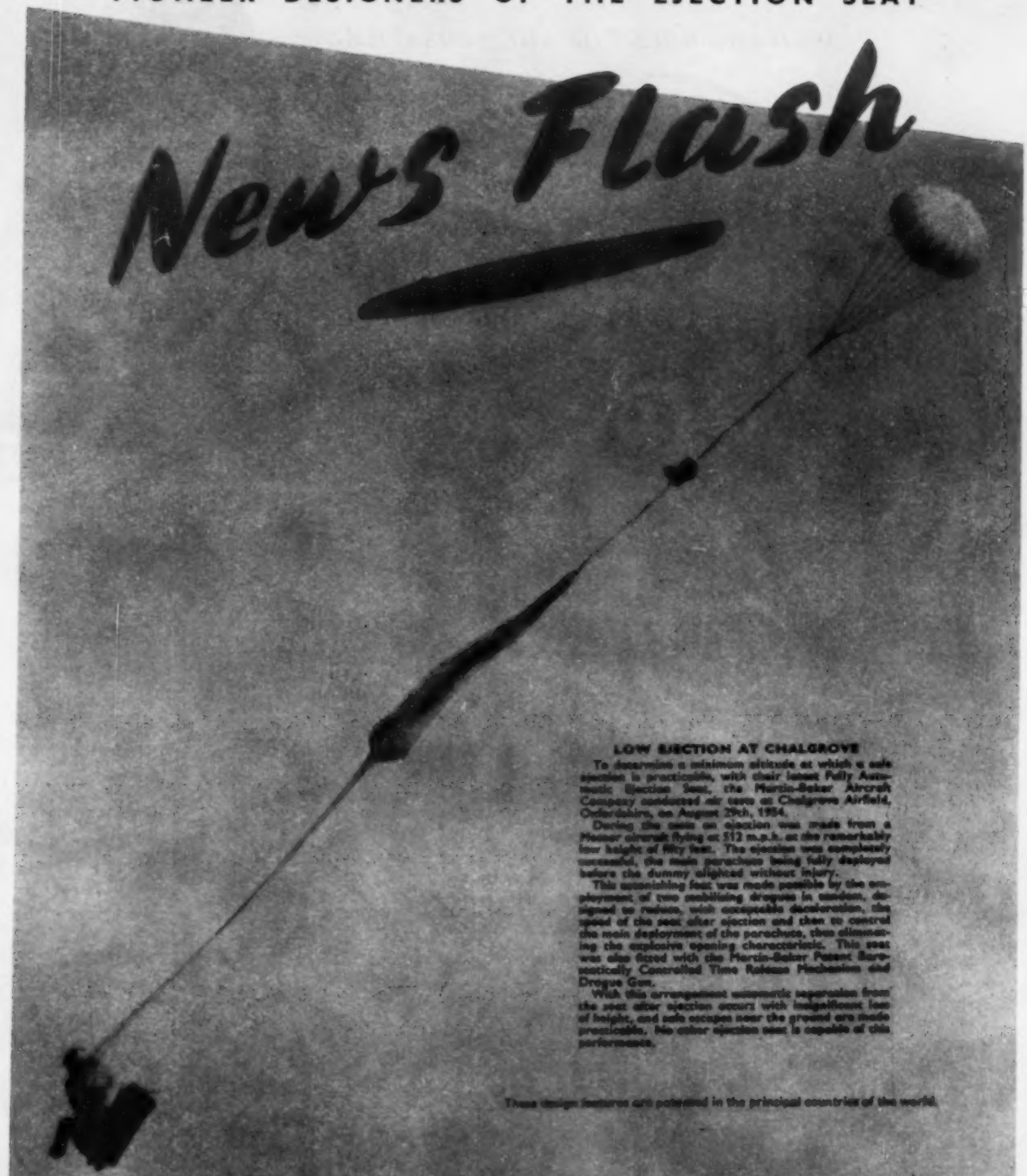
In the design of the Globemaster a detailed study was made of the vehicles and equipment to be carried, and from this it appeared that the most practicable arrangement was one utilizing a forward loading ramp. Since pressurizing was not called for, such a location permitted a large opening, together with a relatively simple ramp; furthermore, it precluded cutting into the fuselage structure, which was carrying heavy tail loads. The opening measures 11ft 4in wide and 11ft 8in high, and is enclosed by two clamshell doors operated by hydraulic cylinders. The ramp is an integral part of the aircraft and is retracted to the stowed position by other hydraulic cylinders; since it is inclined at only 17 deg, vehicles weighing up to 50,000 lb may easily be driven up and into the aircraft under their own power. A pulley installation and an external winch permit large items of equipment to be pulled in and out.

Certain vehicles and guns have an excessive "overhang," requiring a ceiling height over 12ft to provide clearance by the time they have reached the upper end of the ramp. To utilize this great height for carrying additional troops or stretcher cases, auxiliary floors, which may be folded out of the way when not required,

(Below) Fairchild C-119H, showing how all fuel is carried externally under the wings of this variant. (Right) Hurel-Dubois H.D.31.



PIONEER DESIGNERS OF THE EJECTION SEAT



LOW EJECTION AT CHALGROVE

To determine a minimum altitude at which a safe ejection is practicable, with their latest Fully Automatic Ejection Seat, the Martin-Baker Aircraft Company conducted air tests at Chalgrove Airfield, Oxfordshire, on August 29th, 1954.

During the tests an ejection was made from a Meteor aircraft flying at 512 m.p.h. at the remarkably low height of fifty feet. The ejection was completely successful, the main parachute being fully deployed before the dummy alighted without injury.

This astonishing feat was made possible by the employment of two stabilising drogues in tandem, designed to restore, with acceptable deceleration, the speed of the seat after ejection and then to control the main deployment of the parachute, thus eliminating the explosive opening characteristic. This seat was also fitted with the Martin-Baker Patent Barometrically Controlled Time Release Mechanism and Drogue Gun.

With this arrangement automatic separation from the seat after ejection occurs with insignificant loss of height, and safe escapes near the ground are made practicable. No other ejection seat is capable of this performance.

These design features are patented in the principal countries of the world.

MARTIN-BAKER

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MILITARY ROLES OF THE VERSATILE

Pembroke

COMMUNICATIONS

Fuel providing a still air range of more than 1,000 miles (1,609 kms). Accommodation for 8/10 passengers with a crew of 2 and full radio equipment.

FREIGHTING AND SUPPLIES

Quickly removable seats expose large cabin for bulky freight stowage. Main door opening 5ft. 2in. (1.57 ms.) x 4ft. 2ins (1.27 ms.) permits parachuting supplies.

AIR SURVEY

Vertical, oblique and forward facing oblique camera apertures, with fuel for 1,000 miles (1,609 kms.) range. Accurate photography from over 20,000ft. (6100 ms.).

Adapted also for six stretcher Ambulance, Navigation/Bombing training, long-range Ferrying and twin-engine Pilot Training.
The Pembroke has already been ordered by The Royal Air Force, The Royal Rhodesian Air Force, The Royal Belgian Air Force and The Royal Swedish Air Force.

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MILITARY TRANSPORTS . . .

The Blackburn Beverley C.1 prototype, showing the rear loading doors removed for heavy dropping. Beverleys are now in production for the Royal Air Force.

have been developed; these permit 200 troops, or 127 stretcher patients and 31 attendants, to be lifted. The floors also allow segregation when carrying mixed loads such as cargo and troops, or troops and stretcher cases. To supplement the nose loading provisions and permit simultaneous loading or unloading at two stations, a freight lift is installed at the rear of the main cabin, worked by two electrically-powered hoists which are capable of raising a 16,000 lb load. An elevator platform is normally provided, but alternatively the hoists can be hooked directly to the load. Once the load is aboard, the hoists can be controlled to traverse the length of the cabin, enabling the load to be placed at any desired location on the floor. This rear-loading well, with the platform removed, is an effective means for the air-dropping of cargo.

American planners foresee strategic transports capable of carrying 100,000 lb payloads over transatlantic ranges, and to explore the problems of operating such heavy "logistics" carriers the solitary Convair XC-99, with six Pratt and Whitney Wasp Majors, is being operated. Transport counterpart of the B-36 bomber, this huge machine was regarded, when it was delivered in 1949, as a white elephant, but in practice proved itself a most valuable asset. By August this year it had logged 4,105 flying hours on 508 flights, carried over 36½ million pounds of U.S.A.F. cargo, and had reduced operating costs to 11.2 cents per ton mile. It had taken off fully loaded from a 5,400ft runway and had operated with a payload of 104,000 lb from a runway at an altitude of 5,000ft. On one trip it hauled the complete ground equipment of a fighter wing 2,330 miles non-stop across the American continent.

For this monster preloaded cargo bins have been developed to fit on the upper deck, leaving the larger stowage space below free for such items as jeeps and aircraft engines. Experience has been so encouraging that it is estimated that a 100,000 lb-payload transport, designed from the outset to make use of bins, could be fully loaded in 30 min.

The Soviet Union is known to have used a version of the Tu-4 (Boeing B-29) bomber for paratroop dropping, but there is no firm indication that Russia maintains a modern long-range force of military trooper/freighters in any way comparable with that available to the U.S.A.F. and Navy.

Having sketched the "strategic" equipment of the present, we may glance ahead to a remarkable metamorphosis centring on the use of turboprop and turbojet power plants. In this connection it is appropriate to quote Lt-Gen. Joseph Smith, commander of America's Military Air Transport Service (MATS), who has avowed that the U.S.A.F. needs a transport capable of travelling 3,000-3,500 nautical miles non-stop at a speed not less than 575 m.p.h. The concept of a multi-purpose aircraft for MATS, he said, was no longer valid; and he maintained that two types of turbine-powered transports were needed, of which the pure-jet machine would be used for the transport of personnel, casualties, whole blood, nuclear supplies, perishables and "anything else needing special care and speedy transit." Because all combat forces would eventually be pure-jet, it was inevitable, he thought, that transports should also be turbine powered in order to be "harmonious and compatible" with the tactical units which have to be supported in peace and war. The transport envisaged by the General would have a payload of over 30,000 lb or 100 passengers, and would be required to operate from the "average" airfield having runways 5,000-6,000ft long—without the use of assisted take-off boost or parachute braking. Some system of reverse thrust, therefore, was considered mandatory. "The jet transport we are looking for," said the General, "should be relatively easy and simple to operate and certainly no more complicated than the conventional transport. We cannot, for example, accept limitations in performance so fine that a one- or two-degree change in pitch during take-off will be critical." He went on to say that easy transition from conventional aircraft was a requirement, since the jet transports must be suitable for operation by average air force crews of a level of competence expected during emergency mobilization. Easy servicing, rapid loading and unloading, and rapid refuelling, must be possible, and overall maintenance simplified and subject to accomplishment by "our unstable and partially skilled military labour force." One jet transport "of the type now appearing" (presumably the General had in mind the Boeing 707) could replace, in terms of general cargo, nine to ten C-54s, three to four C-97s, three to four C-118s, and two to three C-121Cs, over a range of 2,500 miles; flying 140 hours a month, it could deliver about 900 passengers a month to Europe, whereas a C-54 could deliver only about 170 and a C-118 about 270.

Specific reference may be made to two pure-jet military transports now under development. The first is Britain's Vickers-Armstrongs 1000, a prototype of which was laid down early last year—since which time the type has been ordered into production. The power plant is four Rolls-Royce Conway by-pass units, reconciling high thrust with unusually low specific fuel consumption. A civil variant, designated VC-7, is rumoured to have accommodation for up to 150 passengers and to be designed for a cruising Mach number in excess of 0.9. The long-range version of that aircraft would weigh some 220,000 lb.

The second machine is the Boeing 707 Stratotanker, a military development of which, known as the KC-135, has been ordered as a jet tanker/transport. The characteristics of the Type 707 are well known, having been described in detail in our issue of May 28th, 1954. The KC-135 will be heavier (all-up weight well in excess of 200,000 lb), longer, and would have more powerful turbojets than the present Pratt and Whitney J57 two-spool units of 10,000 lb static thrust.

The future for the airscrew-driving turbine looks equally bright in the military field, and General Smith has declared that MATS will require a turboprop cargo aircraft carrying a 50,000 lb payload over 4,000 miles. Speed is not regarded as critical, but must be compatible with maximum overall economy of operation. Like the pure-jet transport, it must operate without external assistance out of medium-sized fields with runways of 5,000-6,000ft, be capable of fast turn-rounds, and be easy to maintain. Reliability and simplicity of access for maintenance are overriding requirements. Such an aircraft would permit MATS to "reduce its relative man-power, facility and supporting equipment requirements through a reduction in the number of airframes to do its job," says General Smith.

The nearest approach to the requirements outlined is Lockheed's brilliant YC-130, the first prototype of which has already completed a great deal of flying, while the second is nearly ready to take the air. (It was lately learned that the first machine has taken off, levelled out at a height of 10ft, landed, and rolled to a stop without brakes in under 3,500ft).

The new Lockheed is powered with four Allison T56 turboprops and makes greater use of integrally stiffened skin than any aircraft to date (about 120 components). It was designed to meet a U.S. Army requirement for an aircraft to carry troops, paratroops, casualties and all types of ground force equipment, including items weighing as much as 20 tons. The paragon envisaged was to meet tactical requirements and at the same time serve MATS as a long-range passenger transport. From the various requirements the U.S.A.F. compiled specifications for a machine to fly at low altitude and low speed for parachute drops, or high altitude and high speed for long-range work. It had to be adaptable for short assault missions or for transatlantic and trans-Pacific crossings. The freight floor had to be at exact lorry-height—45in from the ground—and the wing had to be placed high, so that the undercarriage could not be conveniently retracted. Accordingly, two huge wheels, one behind the other, were placed in fairings on each side of the fuselage. Notwithstanding the vast rear-loading doors, the fuselage is fully pressurized, and the interior will be warmed by heating the floor. All tie-down fittings will take a 10,000 lb load, and there will be other fittings stressed for loads of 25,000 lb. The maximum speed is expected to reach 400 m.p.h., and the gross weight, for the present at least, is about 130,000 lb.

As in the civil field, turboprop developments of the Super Constellation are in hand, notably the R7V-2 for the U.S. Navy (with Pratt and Whitney T34s). This very fast aircraft is capable of cruising at speeds up to 440 m.p.h. and of carrying over 100 passengers, 73 patients and attendants, or 36,000 lb of cargo over

First production-model Chase C-123B Avitruc built by the Fairchild Aircraft Corporation. The engines are Pratt and Whitney R-2800s.

MILITARY TRANSPORTS . . .

a range of 3,000 miles. Two Boeing KC-97Gs are also undergoing conversion for turboprop power, and under the designation C-133 Douglas have an improved—and somewhat larger—version of the YC-124B; this is itself an experimental development of the "A" and "C" models of the Globemaster II, powered with Pratt and Whitney T34 turboprops. Unlike the "A" and "C," the new version is pressurized to give 8,000ft interior at 30,000ft, and a 64,000 lb design payload can be lifted at the gross weight of 200,000 lb.

The very large (100,000 lb payload) turboprop aircraft to which reference has already been made is likely to materialize as the Douglas XC-132. Remarkably enough, a machine of this calibre (three examples to be precise) already exists in Gt. Britain as the Saunders-Roe Princess flying boat, designed to fly at a gross weight of 330,000 lb and to cruise at speeds up to 380 m.p.h. Having a capacity for 200 troops and a range of 3,500 miles, the Princess is claimed to be able to carry in one year, on strategic routes, as many troops as three ordinary troopships.

Though smaller than the Princess (it weighs about 80 tons all-up) Convair's R3Y Tradewind promises to give a magnificent rendering in the transport role, for it will carry up to 24 tons of cargo on an 88ft by 9ft deck, and this can be loaded through a bow door 8ft 4in wide and 6ft 8in high. Additionally there is a 10ft wide door on the aft port side. The main cabin has been kept clear by a multi-cellular arrangement of watertight bulkheads which extend upward only to floor level; the main deck is made of extruded magnesium throughout, and the cabin is fully pressurized. Typical loads are four 155 mm howitzers, three 2½-ton trucks, six jeeps, or two half-tracks, and maximum speed is in excess of 350 m.p.h. For personnel transport 103 rearward-facing seats can be installed, or for casualty evacuation, 92 stretchers.

Known as the "flying LST," the R3Y-2 can be headed straight into a beach for unloading, in which operation up to 40 per cent of the output of the four Allison T40 turboprops can be employed as reverse thrust to get the machine back into clear water.

As the nation which pioneered the development of the turboprop, and its introduction into service, Great Britain is possibly alone among the powers in having no military turboprop transport under development. It is obvious, of course, that the Bristol Britannia has attractive possibilities in this direction, though it could not compare with the Lockheed C-130 in facility of loading and in other operational aspects. Meanwhile, R.A.F. Transport Command will be supplied with a small number of Blackburn Beverleys, powered with Bristol Centaurus piston engines. Precise details of this aircraft are not available, but the civil Universal, which is almost identical, would weigh about 61 tons and have a main cargo hold measuring 40ft×10ft×10ft. Ten jeeps could be carried in the main freight compartment in addition to troops.

The Beverley is the first British aircraft designed to enable heavy army equipment to be dropped from the air, and for this purpose its rear loading doors are removed. The fixed undercarriage, with bogie wheels, permits operation without the use of prepared runways, and in a light wind, using its wheel brakes but not its braking airscrews, the prototype has been using less than half the maker's 1,400-yd runway for landing. The Beverley is a comparatively slow, short-range aircraft, and unpressurized.

Military experiments continue with France's Breguet 763 double-decker, and on page 679 an AMX tank weighing 13.9 metric tons is shown going aboard this machine, the upper cargo floor of which was removed to accommodate the turret and 5½-yd-long gun barrel. The 763 can carry 4,000 lb of stores, in addition to an AMX tank, for 1,250 miles.

For general-purpose transport duties over relatively short ranges a variety of piston-engined machines at present holds the field, and a possible replacement in this category was discussed in an article by Lt-Col. P. A. Tobin in our issue of October 22nd.

In R.A.F. service the standard type is the Vickers Valetta C.1 (two Bristol Hercules 230s), which has a side loading-door giving access to its cabin of 1,565 cu ft volume. A range of about 1,400 miles is attainable at the economical cruising speed of 172 m.p.h., and typical loads are 34 troops, 11,380 lb of freight, 20 troops plus six 350 lb containers, or 20 stretcher and two sitting cases.

Exported to certain overseas air forces, the military version of the Bristol Type 170 is a very attractive proposition by reason of its nose-loading doors, giving access to the cargo hold of 2,020 cu ft capacity. Height is sufficient to accept a loaded three-ton lorry, or there is room for three jeeps, a Bofors gun and a jeep, or four engines of Hercules or Merlin size. In the heavy-dropping role the Type 170 is at the same disadvantage as other British transports, except the Beverley.

With an admirable grasp of requirements America many years ago produced the famous Fairchild Packet, with its now-familiar twin-engined, twin-boom, rear-loading layout. Numerous versions have been built and are in service, but representative is the C-119F, with two Wright R-3350 engines. The Packet's cargo hold measures 36ft 11in long, 9ft 10in wide, and 8ft high, giving a volume of 3,150 cu ft. From machines of this type U.S. Army and Air Force crews have parachuted such equipment as a 21,000-lb tractor, with bulldozer, an 18,000-lb grader, a 17,500-lb dump truck, and a 13,000-lb scraper. Normal seating capacity is 67, for emergency evacuation up to 78 can be taken. In the cas. evac. role provision is made for 35 stretchers, and a monorail is provided to handle 20 dropping containers each of 500 lb. Range is 2,300 miles.

The C-119H is an experimental development with new wings of high aspect ratio (photograph on page 680), new tail surfaces and undercarriage, and Wright Turbo-Compound engines. All fuel is carried in external under-wing tanks, and maximum cargo capacity is increased to 27,200 lb. No production order for this machine has been announced, nor has development of the Fairchild Pack-Plane (with detachable fuselage) proceeded, though the principle of that design is still under consideration.

Fairchild are reported to have under development a turboprop transport for operation from unimproved fields, and it is known that they have been conducting experiments with a J44 turbojet of their own make mounted on the fuselage of a C-82 Packet. This is expected to allow an increase in maximum take-off weight of between two and three tons, and the mounting of multiple J44 "packages" on the fuselage or wings is in view.

A specialized casualty evacuation machine in U.S.A.F. service is the Convair C-131A Samaritan, with provision for 27 stretchers and seven seats, and for iron lungs and special oxygen equipment.

Laid out according to the Packet formula, but smaller and lighter, and powered with two Bristol Hercules engines, the Nord 2501 Noratlas, now in service with the French Air Force, has a stowage capacity of 1,800 cu ft and is suitable for heavy dropping. Gross weight is just over 43,000 lb. Standard Russian equipment in the same class is the Il-12, which, having only side-loading facilities, is unsuitable for heavy dropping. Cruising speed is about 200 m.p.h., and Il-12s are still extensively used for glider towing. The military value of the glider has, however, diminished vastly since the war, but there is still an American requirement for an "assault" transport, i.e., one capable of operating from short or unprepared fields with troops, cargo and military equipment. The type in production (at the Fairchild plant) is the Chase C-123B Avitruc, which has a top speed of 240 m.p.h. It can carry 61 fully equipped troops, or 50 stretcher cases and six walking wounded, together with five nurses and 1,300 lb of medical equipment. Assault loads include guns and vehicles. The engines are two Pratt and Whitney R-2800s and stalling speed is believed to be as low as 75 m.p.h. With maximum load a range considerably in excess of 1,000 miles is attainable. A large rear-loading door is one of the numerous practical features.

Also mooted as an assault transport is France's Hurel-Dubois H.D. 32, fully described in *Flight* of June 18th, 1954.

Although this review has not been concerned with the lighter types of transports for military use, final reference may be made to the projected rear-loading military development of the Scottish Aviation Twin Pioneer, and to the Folland light transport, with 1,050 cu ft capacity and four Gipsy Queen engines.

INDONESIAN FIRST-BORN

Ground-attack Single-seater for I.A.F.

THE first aircraft to be designed and built in Indonesia was constructed by the Aero-technical Branch of the Indonesian Air Force and is now completing its flight test schedule. It made its first flight on August 1st last at Husein Sastranagara A.F.B., Bandung, Java. Significantly this first venture, called NU-200 Sikumbang (Bee), was designed to fulfil an operational rôle similar to that of the Fletcher Defender in the U.S.A. and Japan. It is, in fact, a light ground-attack single-seater with a maximum all-up weight of 2,400 lb; it is powered by a 200 h.p. D.H. Gipsy Six driving a two-blade fixed-pitch wooden airscrew.

The accompanying photograph shows it to be a low wing monoplane of conventional configuration with a fixed tricycle undercarriage. The pilot sits just above the leading edge under a sliding cockpit canopy which, together with the distinctive fuselage upper contours, should provide an excellent view; the engine is slung quite low forward of a Harvard-like hump in the cockpit coaming. No details of armament are released, but it would appear that mountings are provided for two machine guns in the wings with other stores such as rockets, bombs or napalm slung beneath the wing.

Construction is composite. The wing is a single-piece wooden structure with plywood covering, having an aspect ratio of 6.5, a N.A.C.A. 23012 aerofoil section and an area of 182 sq ft. Its split flaps are electrically operated. Two sets of fixed slots are positioned opposite the ailerons in each wing. The tail surfaces are likewise cantilever wooden structures with trim tabs on rudder and elevator. The fuselage, on the other hand, is of welded steel tube with metal covering. The undercarriage is fixed and employs oleo shock-absorbers, and the nose wheel is not steerable. Span, length and height are, respectively, 34.8ft, 26.75ft and 11ft. Maximum and cruising speeds at sea level are quoted as 160 m.p.h. and 140 m.p.h. and landing speed as 55 m.p.h.; initial rate of climb is "over 1,000ft a minute" and service ceiling 16,500ft. Range, with a total fuel capacity of 40 Imp. gallons, is stated to be 600 miles.

Indonesia's first home-designed and built aircraft, the single-seat light ground-support NU-200 Sikumbang (Bee) is here seen airborne over Java during a test flight.

THE FLEURET IN INDIA

THE practical aspects of conversion from light piston-engined trainer to light jet trainer were recently demonstrated in a series of tests by the Indian Air Force, using the Morane-Saulnier MS.755 Fleuret. This experiment, under Service conditions, followed the I.A.F. decision in May, 1954, to adopt the French "light jet trainer" formula, and was carried out at the Air Force Academy No. 1 at Begumpet airfield, Hyderabad.

The experiment was conducted with four pupils, and showed that the average pupil-pilot with 60 hr piston-engined experience (in this case on the Percival Prentice) could easily convert onto a jet machine and safely solo after a period of between 7 and 12 hours' dual. Side-by-side seating was found to be preferable for a jet trainer used in this manner, i.e., relatively early in the flying training programme. In addition, a pupil with only 10 hr dual and 1½ hr solo on a Tiger Moth received 4 hr dual on the Fleuret, and was checked and found safe for solo by the maker's pilot.

A total of 105 flying hours was achieved, an average of 3½ hr per working day, made up of 128 flights and 282 landings. Of this total, 58½ hr were flown by the pupils, on dual, solo and check flights, and the remainder by the Morane-Saulnier pilot and the I.A.F. instructors on demonstration and evaluation flying (including night flying). Total maintenance time required was 287 hours, an average of 2.45 hr per flying hour.

JAPANESE DEFENCE PRODUCTION

A THREE-YEAR defence production programme is being prepared by the Japanese Ministry of International Trade and Industry to fulfil the requirements of the programme laid down by the Defence Agency. Some 29,400 million yen (approximately £30m) will be spent to strengthen the country's "Self-Defence Forces" and specifically to increase the Land Self-Defence Force to 180,000 men, and the Air Self-Defence Force to 1,300 aircraft. The programme allows for production of replacement equipment required in the next three to five years.

The programme covers the construction of 200 jet fighters and 60 jet trainers each year, and for the following piston-engined types: 60 basic trainers, 60 advanced trainers, 40 twin-engined transports, 30 anti-submarine attack aircraft, and 60 liaison aircraft. It is also planned to produce 40 medium-sized and 60 small helicopters. Various proportions of the total financial appropriation are allotted for aircraft, arms, ordnance and fuel. The Ministry, it is reported, does not consider that the industry is yet capable of producing guided missiles, rockets or other special weapons. Some two-thirds of the first year's total appropriation is expected to be devoted to the construction of warships.

In connection with the programme, Gen. Hull, commander of U.S. Far East Forces, recently called a conference which was attended by Gen. Hayashi, chairman of the Japanese Joint Chiefs of Staff, and the chiefs themselves—Gen. Tsutsui (army) Admiral Nagasawa (navy) and Gen. Kamimura (air force).

ULTRASONIC THICKNESS-GAUGE

IN the orthodox type of ultrasonic thickness-gauges, working on the resonance principle, the operator must turn a calibrated knob to vary the frequency of the signal and must judge the resonance point from the sound in his headphones. In a new instrument marketed by Dawe Instruments, Ltd. (130 Uxbridge Road, Hanwell, London, W.7)—known as Type 1107 Visigauge—both these operations are carried out automatically by the instrument itself. This greatly reduces the time required for each measurement and, it is stated, increases the accuracy reading. A typical accuracy claimed, over the lowest of the five available ranges (in steel 0.015 to 0.030in) is a maximum error of only 0.0006in on a reasonably smooth material, when set up against a standard test block.

GERMAN INTEREST IN LIGHT AIRCRAFT

AN exhibition of light aircraft was staged at Munich-Riem Airport at the beginning of the month under the sponsorship of our German contemporary *Der Flieger*. In the interim between the granting of permission to build and the appearance of indigenous German designs in numbers, it is considered that a sizeable market must exist for foreign light aircraft in Germany. Foreign constructors were therefore invited to exhibit at Munich-Riem, and many aircraft, particularly Italian and American, were on show both on the ground and in the air. From Italy came a Piaggio P.136 amphibian and a Rondone F.4. The new Airone F.6 did not receive clearance in time and was therefore unable to be present. A KZ.7 arrived from Denmark, and from the U.S.A. a Cessna C.170, C.180 and C.195, together with a Piper Cub. Particular interest was aroused by details of the Temco Plebe, which, it is said, will be built in Germany.

The only British aircraft shown were a Tiger Moth and a de Havilland Rapide. Four previously announced Czech aircraft, the Aero 45, the Zlin 22, Sokol and Pionyr, and various Walter engines, were not granted entry permits and could not be shown. Indigenous German exhibits included the powered version of the Dittmar Möve, the Doppelraab and the new Greif 1 gliders, as well as items of aircraft equipment. Two Americans, Stits and Nelson, exhibited respectively the Playboy aircraft for home construction, and the 40 h.p. Boxer H.49 engine, reported to sell for Dm 3,000. The exhibition will be repeated next year.

Pensacola and Corpus Christi

Fleet Air Arm Training with the U.S. Navy

UNDER the M.D.A.P. flying training scheme initiated in 1952 a number of prospective Fleet Air Arm pilots have joined European and certain South American nations' pupils to qualify as pilots with the U.S. Naval Air Training Command. At present 110 R.N. officers are undergoing training and 100 have qualified during the last year.

The U.S. Naval Air Service is probably the largest such organization in the world and its air training command alone includes 34 airfields, 4,228 aircraft and 100,905 personnel under the overall command of Vice Admiral A. K. Doyle, U.S.N. Vice Admiral Doyle is himself an experienced carrier captain and task force commander—he commanded a carrier task force during exercise Mainbrace. The U.S. Naval Air Training Command, the largest command based ashore, is responsible for the training of student pilots, skilled aviation technical personnel and for maintaining proficiency of the Naval Air Reserve. It is divided into four sub commands as follows: Naval Air Basic Training Command, Pensacola, Florida; Naval Air Advanced Training Command, Corpus Christi, Texas; Naval Air Technical Command, Memphis, Tennessee and the Naval Air Reserve Training Command at Glenview, Illinois.

Pensacola, where all direct entry and non-U.S. trainees are first posted, is situated on the Gulf of Mexico in the north-west corner of the Florida "Panhandle" about 200 miles east of New Orleans. The town is about as large as Weymouth and it derives most of its livelihood and prosperity from the U.S. Navy. The Naval Air Station itself is some five miles west of the town and here American naval aviation was born. Pensacola Airfield itself is not amenable to extension and too small for large or fast modern aircraft. The basic training programme is, therefore, carried out at 27 different airfields within a 45-mile radius of Pensacola, and some idea of the scale of activity can be gained from the fact that at Whiting Field alone there are about 350 aircraft—all trainers. On any working day as many as 550 training aircraft may be airborne in the Pensacola area at any time.

The advanced Training Command headquarters at Corpus Christi in Southern Texas, not far from the Mexican border, is some 800 miles from Pensacola. It lies close to the great oil fields of Texas and to the King Ranch, the largest cattle producing ranch in the world. Four large satellite stations are attached to Corpus Christi and are situated within 80 miles of it.

The student begins his training with an intensive five weeks' course in the U.S. Naval School of Pre-Flight at Pensacola. The course covers navigation, meteorology, engineering, principles of flight and study skills; heavy emphasis is laid on physical training and games, and every student must pass a swimming test. The next stage is the Primary Flying Training School of which there are two, one at Whiting Field 40 miles north of Pensacola where the majority of aviation cadets and R.N. Midshipmen are sent and the other at Corry Field close to Pensacola where the majority of officer students are trained. The primary course consists of three stages of instruction given in the SNJ (Harvard) which is still in general use, but is shortly to be replaced by the Beech T-34 Mentor. Pilots go solo after not less than 24 hours dual and then they complete 20 hours precision flying and basic air work before passing into the final phase of 25 hours dual and solo aerobatics and emergency procedures.

A neat echelon of S.N.J.s (Harvards) flown by pupils from Pensacola Naval Air Station where British pilots are being trained.

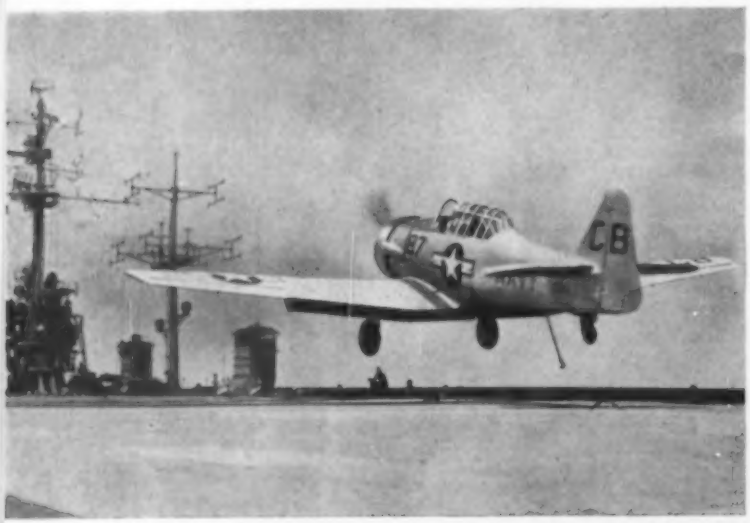
The next move is to Saufley Field, 12 miles from Pensacola where the pupil pilot first learns formation, cross country and night flying. Six weeks later he moves to Baring Field, 35 miles west of Pensacola in Alabama, for a three weeks' primary course in air-to-air and air-to-ground gunnery, culminating in a series of AADLs and six landings on the carrier U.S.S. *Monterey*. This ship is a light carrier permanently attached to Basic Training Command and holds the record for carrier landings with 90,000 touch-downs since her first commission during World War II. Basic training is then rounded off with a four weeks' course at Corry Field in basic instrument flying and night flying.

Pupils then transfer to Advanced Training Command to acquire their operational techniques (all U.S.-trained R.N. pilots are trained for fighters) but they first take the gruelling six weeks' course with the All-Weather Squadron at either Corpus Christi or Kingsville. Originally this was done in Beechcraft Expediters but more recently the North American T-28B has become standard. Most of this six weeks' course is spent in applied instrument flying, principally concerned with controlled descents, G.C.A.s, radio range flying and over cloud navigation.

Pilots now have a thorough grounding in the basic principles of flying and are ready for their first taste of jets, flying Lockheed TV2s (U.S. Navy T-33s). Finally, before receiving his wings from the Chief of Naval Air Advanced Training, the R.N. pilot spends some 50 hours flying the Grumman F9F-2 Panther. This is, of course, a single-seater and in it he learns to fire rockets and cannons and to drop bombs as well as learning fighter tactics and jet cross-country and night flying.

Owing to the lack at the moment of a training carrier large enough for jet aircraft, no jet carrier landings are practised before qualifying, but this is expected to be remedied in the not-too-distant future. At present U.S.-trained pilots will make their first jet carrier landings when they reach the squadrons. Despite an organization vastly more elaborate than the Fleet Air Arm the U.S. Navy training course provides approximately the same training as its British counterpart. Pilots fly about four different types of aircraft, two of them jets and one of these a single seater, though this is not of high performance, being equivalent only to the Meteor.

Probably the most significant phase of the U.S. Navy training



With the flight deck crews preparing to handle it, an S.N.J. from Corry Naval Air Station is poised for touch-down on the deck of the U.S.S. "Monterey" training carrier.

is the six weeks tour with the All-Weather Squadron. This, for the average U.S. Navy flier, is a basic necessity since during his training he must learn to use a variety of radio navigation aids with which his operational aircraft will almost certainly be equipped. U.S. Navy aircraft carry out a good deal of cross-country flying in the United States and the radio facilities at their disposal for this purpose are considerable. Even so, such an intensive course in applied instrument flying probably has no equivalent in Britain and its usefulness cannot be over-estimated for pilots destined to fly jet aircraft.

The whole course takes some 18 months and apart from the excellent training received, such a sojourn in the United States in close contact with Americans is a great experience for those who are trained there. There are comparatively few R.N. officers serving with the U.S. Navy and they have during their time there an excellent opportunity of getting to know Americans and America. Their standard pay, which would otherwise be inadequate to cope with the high cost of living, is augmented by an allowance, which makes it comparable with that of an American of equivalent rank. After procuring uniform and the necessary tropical kit, the R.N. officer is in a position to maintain himself quite well even to the extent of purchasing a car. This last item of equipment is practically a necessity and can be obtained quite cheaply, particularly with the reasonable hire purchase terms available.

Considerable hospitality is extended by Americans to R.N. officers under training. Furthermore R.N. personnel have formed cricket and rugby teams and have successfully played against a number of U.S. clubs including a recent fixture at Hollywood with a completely free week-end of entertainment thrown in. Last winter a rugby match was played against a team from H.M.S. *Sheffield* which then wore the flag of the C-in-C, America and West Indies Squadron, when the cruiser visited Pensacola. The same team later flew to Bermuda to take part in the annual rugby meeting where they beat the U.S. Navy, Bermuda, 6—3. Dartmouth, Princeton, and Harvard Universities and the Bermuda Rugby Club were dispatched in like manner and the R.N. team was only beaten by a Canadian touring side. Incidentally, it was found that several American girls' colleges were on holiday in the district.

Lifts to even remote parts of the States are often obtainable in service aircraft, but Pensacola itself during the summer offers excellent facilities for swimming, water ski-ing and spear fishing. During longer leave periods many of the officers are invited to private homes and have visited friends in all parts of the United States. Altogether flying training in the U.S.A. constitutes an interesting, useful and instructive experience for the prospective Fleet Air Arm pilot. He could hardly wish for a more auspicious start to a Service commission.

FAWLEY

The Largest Refinery in the United Kingdom

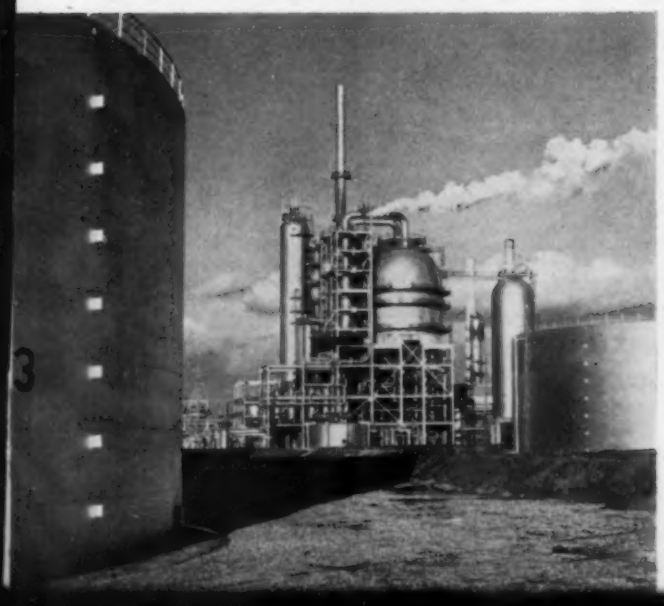
SINCE 1945 the aggregate British refining capacity has increased from less than three million tons per year to about 29 million tons per year. Of this huge total—exceeded only by the U.S.A. and the Netherlands West Indies—about one-quarter is supplied by the Esso Petroleum Company's refinery at Fawley, on the west side of Southampton Water.

This immense installation was first put on stream in 1951 and it has since saved considerably more than 300,000,000 dollars which would otherwise have been required to purchase refined petroleum products. We visited the refinery last week and were able to obtain a fair picture of its contribution.

Contrary to what obtained before the War, nearly all the crude petroleum supplied to Fawley comes from the Middle East, and is purchased predominantly for sterling. One of the few invariables in the economics of a refinery is the fact that a ton of crude oil will, when refined, produce a more or less constant proportion of a whole range of products, ranging from gaseous petroleums, naphtha, butane (Calor gas) and similar fractions, right through the various petrols and kerosines, down to fuel oils, lube oils and pitch. Fawley's total output to date has been approximately as follows: petrol, 5.6m tons (1,700m gal); kerosine, 600,000 tons (175m gal); and gas oils and fuel oils, 10.5m tons (2,500m gal).

Fawley does not supply petrol for piston-engined aircraft. It does, however, produce a great deal of aviation turbine fuel. Most of this is in the form of wide-cut gasoline (D.E.R.D. 2486 or MIL-F-5624A or JP-4), although there is a steady demand for kerosine for such aircraft as the Viscount. The trend is towards wide-cut, which has now almost entirely superseded the original JP-1 paraffin-type fuel used in military aircraft.

One of the principal units at Fawley is the "cat cracker," about as large as a cathedral, which produces half-a-million gallons of high-grade petrol each day.



The production of wide-cut is fairly straightforward, and Esso are no doubt glad of the demand for a fuel which is, as its name implies, a mixture of a wide range of hydrocarbon fractions. One of the company's major troubles is that it has not, in the past, been possible to produce more heavy fuel oil—for which there is a rapidly rising demand—without at the same time producing more petrol and middle distillates, sales of which are restricted owing to the enormous tax which is imposed on them. Shortly, the Fawley refinery will be made more flexible in output by the installation of a hydroforming plant, costing about £4m, which will be the first such unit in Britain. Briefly, it will process crude fractions in an atmosphere of hydrogen and in the presence of a catalyst to produce 10,000 to 15,000 barrels per day of very high quality aromatic petrol. In doing so it will release a considerable amount of middle distillate at present used as feed-stock for the catalytic-cracking unit (illustrated).

The company were not willing to discuss the point, but it could be concluded that the output of wide-cut gasoline will be capable of being increased as a direct result. Certainly such an increase is being rendered essential by the introduction of large numbers of turbine-driven military aircraft.

H.P. TEST-PILOT APPOINTMENT

A RECENT recruit to the test-pilot staff of Handley Page, Ltd., is F/L. J. W. Allam. Twenty-nine years of age, he has served for the past eleven years with the R.A.F., which he left to take up his present appointment. Educated at Churcher's College, Petersfield, and Christ's College, Cambridge, F/L. Allam received his flying training in the United States and later served, both at home and abroad, in Flying Training and Transport Commands. His duties included "V.I.P." work in India and Pakistan, where he piloted, among others, the late Liaquat Ali Khan, the then Prime Minister of Pakistan; and he was personal pilot to Air Marshal R. L. R. Atcherley when the latter was Commander-in-Chief of the Royal Pakistan Air Force. Allam was a member of No. 9 course at the E.T.P.S., Farnborough, in 1950 and afterwards spent several months as a pupil in the Test Pilot Training Division of the United States Navy before serving in "B" Squadron (bombers and transports) at the A. and A.E.E., Boscombe Down from March 1951 to December 1953. His log-book shows some 3,500 hours on sixty aircraft types.

F/L. J. W. Allam

THE COMET INQUIRY CONTINUES

THIS section of our report on the Comet Inquiry is concerned with the events prior to the tribunal's visit to the Royal Aircraft Establishment on October 27th, and follows on from our report of the opening stages in last week's issue. An account of subsequent evidence is given on pages 669-670.

Friday, October 22nd: Fourth Day (continued).—The discussion of fatigue formed an important part of this day's deliberations. As mentioned last week, Sir Arnold Hall first gave his conclusion that the probable cause of the primary failure in the pressure cabin of Comet YP was this phenomenon. He said he knew of no physical test one could apply to a piece of material which will tell one how much it was fatigued.

If one tested accurate metallurgical specimens one would expect to get points of fatigue that did not differ very much. But with standard material in complicated structures there was a large spread in the time over which fatigue failure might take place. A weak specimen might fail at about one-third the time of an average specimen and a strong one might have about three times the life of an average specimen.

Describing experiments with Comet G-ALYU in the water tank at Farnborough, Sir Arnold said that when failure occurred near the forward escape hatch the structure at that point had a peak stress of 45,700 lb/sq in, and it was deduced that that stress was, in practice, reached two or three times per flight. The ultimate static strength of the material was about 65,000 lb/sq in, so that failure occurred at 70 per cent of the ultimate.

Sir Lionel Heald: The margin or safety factor is not a very large one?—It is not.

The degree of stress concentration at the forward escape hatch, Sir Arnold said, was of the same order of magnitude as that at the A.D.F. window, although the two structures were different. "We examined the fractures in the area of the rear A.D.F. window (of G-ALYP) which we had already decided was the origin of the failure, and we found what we believe to be evidence of high-level fatigue at one particular point. . . ."

On the examination of the area round the windows, Sir Arnold said, "We observed certain cracks which had, I believe, been formed during the process of manufacture of the aeroplane, because they had been drilled at their ends to stop their propagation. . . . The presence of these cracks does rather suggest that the manufacturing process used was one capable of cracking the material. Although you may see a crack which is formed by such a process, one is always a little worried as to whether there are some you do not see. . . . The inference I put on these cracks is that I cannot totally eliminate that they might have accelerated the onset of fatigue in this aeroplane . . . it might have brought the accident a little forward in time; it certainly was not in any sense a primary cause."

Sir Lionel Heald later read from the R.A.E. report the outline of the investigation, and a discussion on the Elba accident. The cabin tests on G-ALYU at Farnborough, it said, demonstrated beyond doubt that the fatigue life of the cabin was relatively short. In reply to Sir Lionel, Sir Arnold said, "If we take YU as unity, YP was 2.4 times younger and YY was 3.4 times younger . . . these ratios are those of a kind that we find reasonably normal. . . . At the time of the Elba and Naples accidents, both aircraft had flown longer than the safe fatigue life we could give in the light of the evidence obtained from YU."

The section of the report concerned with the control-system investigation stated that opinions of test pilots were that it was unlikely that they would be led into difficulties by the control system, though they would prefer that the "break-out" force associated with the elevator control were smaller.

Under "Other technical matters" it stated "In the course of these investigations, it was shown that the wing has a relatively low resistance to fatigue. This did not cause the Elba accident, for the wing did not fail in the 'fatigue-prone' region."

The conclusions of the Farnborough report, read out to the court by Sir Lionel, were as quoted on page 654 of last week's issue.

The next witness, Dr. P. B. Walker, described his theoretical examination of the facts of the Elba and Naples accidents, and the practical tests devised at Farnborough to test the correctness of his conclusion that fatigue of the pressure cabin might be a cause. The fuselage pressurization was tested in a water tank, while fluctuating gust loads were applied to the wings (which projected out of the tank) by means of hydraulic rams. As mentioned, a major failure of the pressure cabin occurred after 9,000 simulated flying hours.

Dr. Walker described his measurements, and gave his opinion that the failure of the cabin at the forward port window (an escape hatch) was due to fatigue at a particular rivet hole. A crack in the wings, though not considered dangerous, did develop at about 6,000 hours. Mr. G. Corfield, fleet inspector of the B.O.A.C. Comet Fleet, next gave evidence concerning the maintenance checks carried out on Comet aircraft. He was asked by Lord Cohen whether he would have expected de Havillands to call special attention to manufacturing cracks on delivering an aircraft to B.O.A.C., and replied that "we would hardly expect to get a new aeroplane with cracks in it, unless it was in a very minor part of the structure."

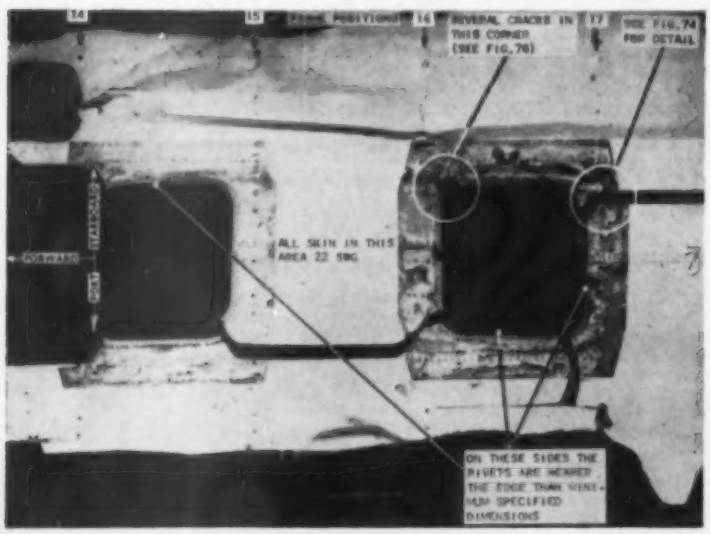
Monday, October 25th: Fifth Day.—Evidence on the condition of the four Ghost turbojets recovered from the wreckage of YP was given by the chief engineer of the de Havilland Engine Company, and Sir Arnold Hall amplified what he had previously said concerning the manufacturing cracks found in the fuselage. The M.T.C.A. chief inspector of accidents spoke on his department's connection with events following the Elba accident, and preliminary evidence was given on the accident to Comet YY near Naples.

At the start of the day's proceedings, Sir Lionel Heald (for the Crown) mentioned a number of letters that had been written to the court. One of these was from a Mr. Jablonsky, who "apparently takes the view that Sir Arnold Hall's evidence is all wrong." After discussion, Sir Lionel undertook to consider a statement from Mr. Jablonsky with a view to his being called as a witness. (The author of the letter referred to is Mr. Bruno Jablonsky, managing director of Jablo Propellers, Ltd., Waddon, Croydon.)

Sir Arnold Hall, director of R.A.E., was first recalled to clarify and expand part of the evidence he had previously given. He emphasized that, whether or not fatigue on YP had been accelerated by the manufacturing cracks found at another corner of the A.D.F. window, "there is no doubt that the aeroplane YU showed a proneness to fatigue in the cabin, which would have overtaken it quite independently of any other manufacturing crack there might be." Cross-examined by Sir Hartley Shawcross (for de Havillands), Sir Arnold said, "The position that I find myself in is that I get to this square foot of this aeroplane near the A.D.F. window and I say, 'That is where it first failed.' It is now, when we start to get down to the square inch from the square foot that we have difficulty. I did my best to assist the Court by saying I thought probably it was at one corner, but I cannot totally eliminate the other because I have no evidence upon which to do that."

Concerning the manufacturing cracks, Sir Hartley said, "In the early stages in the production of the early aircraft, some of this work was done by hand. Later it was done by a rubber pressing machine which distributed the stress more evenly, and we think would have eliminated any possibility of cracks. I would add this, however, that we fully recognize, in view of what has since been discovered about the strength of the pressure cabin, that in future stronger materials would have to be used, and, with stronger materials, the presence of cracks of this kind would have been much less significant."

The next witness was Mr. P. G. Tweedie, chief inspector of accidents at the Ministry of Transport and Civil Aviation, who described how officers of his department had investigated the two Comet accidents, and how it had been arranged to send the wreckage, as it was recovered, to the R.A.E. The metallurgical examination of the engines was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SEVERAL CRACKS IN THIS CORNER (SEE FIG.76)
SEE FIG.74 FOR DETAIL
FORWARD
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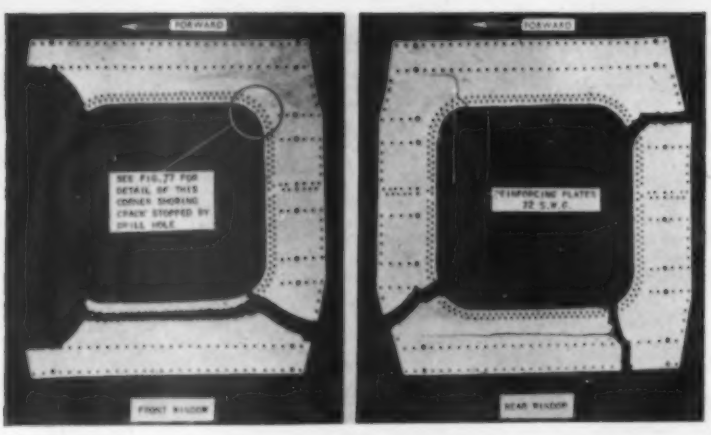
ON THESE SIDES THE RIVETS ARE NEARER THE EDGE THAN STIPULATED SPECIFIED DIMENSIONS



Taken from the R.A.E. report, these photographs show parts of the actual wreckage of G-ALYP. Top, the failure of the top fuselage skin around the A.D.F. aerial windows is seen (detailed view of fatigue failure in top right corner appeared in last week's issue); lower pictures, the failure of the reinforcing plates around these windows.

Similar in many respects to the failure of the Elba Comet was that of G-ALYU under test at Farnborough, which began at the forward port passenger window, an escape hatch. Top to bottom: an exterior view looking forward; a close-up of skin at bottom rear corner of the hatch; and a view of the failure from inside the fuselage.

performed by the de Havilland company, he said, while a second, independent opinion on the turbine-disc hub shafts was given by the metallurgical section at R.A.E. After the complete examination, the engines were sent to Farnborough to be fitted in with the general assembly.

Further details of the inspection of the engines were next given by Dr. E. S. Moult, chief engineer of the de Havilland Engine Company. Referring to the report of his company's investigation, Dr. Moult said that there was no evidence of abnormal functioning of any engine prior to the accident. Although the engines were very badly damaged on impact with the sea, and a good deal of analysis work had to be done, this conclusion was reached because there were no signs of any seizure anywhere, and on none of the engines were there any undue signs of heat.

No evidence had been found that the engines themselves had been on fire, although there were signs of fire in their vicinity. "Had any serious defect occurred within the engines themselves," Dr. Moult continued, "then we should have expected to find much more definite indications in the burning of important components. All the evidence of fire was external." More signs of fire had been found underneath the engines than on top of them, confirming the fact that the centre-section came down in an inverted position. This was also apparent from the impact damage on the top of the engines.

All four impellers had been recovered, and were found to be intact on their shafts, although there was extensive corrosion. One turbine disc was missing, but the other three, practically undamaged, were in position. The turbine shrouds had suffered some damage by impact with the sea, but there had been no penetration of the shroud by either the turbine wheel or any turbine blade. "I am satisfied," Dr. Moult said, "there was no bursting or disintegration of the turbine disc." Mr. J. P. Graham, Q.C. (for the Crown), next quoted two further conclusions from Dr. Moult's report: "There is evidence indicating that the damage sustained by all engines occurred in two phases, but the evidence is insufficient to establish the time interval between these two phases," and "There is evidence that in the first case similar shock loading was imposed upon all four engines resulting in the failure of the hub shaft of No. 2 and producing cracking in the spigot recess radii on the hub shaft flanges of the other three. There is not sufficient evidence for me to say why this loading resulted in the detachment of the turbine disc only of No. 2 engine."

Dr. Moult commented, "At first there was a contradiction in the evidence because we saw some of the damage had undoubtedly occurred while the engine was at rest and there was other evidence which showed —speaking particularly of No. 2 engine—that the damage had occurred while the engines were rotating at some speed. At first we did not understand it but it became more apparent as the investigation proceeded, and we came to the conclusion in the end that the rotating damage occurred at some period due to a shock or to a very suddenly applied moment, whereas the static damage occurred, we feel, on impact with the sea."

Concerning the cracks found in the turbine-disc hub shafts, Mr. Graham asked, "Have you considered what sort of movement of the aircraft could have caused those cracks to appear in the shaft?"—"Well, of course we have no positive proof of that, but it is perfectly consistent with a high gyroscopic loading, in other words a sudden change of direction of the aircraft either in pitch or in yaw."

Mr. Graham: You heard my learned friend Sir Lionel, when he was opening this case, say something to this effect, that the engines can be given a completely clean bill of health. Do you agree with that statement?—Yes, I agree that the whole evidence indicates that the engines in no case were the prime cause of failure of the aircraft.

Formal evidence concerning the second Comet accident, that to G-ALYY near Naples, on April 8th, was next presented to the court. The first witness was Capt. D. E. Holland Martin, D.S.O., D.S.C., R.N., who was in command of H.M.S. *Eagle* at that time. H.M.S. *Eagle* and H.M.S. *Daring*, he said, were ordered to search for the missing Comet on April 9th. Throughout that day, Avenger aircraft from *Eagle* carried out searches, until in the afternoon bodies were sighted and reported 30 miles N.E. of Stromboli by an Elizabethan airliner. By nightfall, five bodies had been recovered by the boats from *Eagle* and *Daring*.

Nothing of any significance was recovered the next day, Capt. Holland Martin continued. The depth of the water in the area where the bodies were found varied between about 520 and 580 fathoms.

Mr. P. C. Pinfield, B.E.A. station superintendent at Ciampino Airport, was next recalled, and stated that he had noticed no unauthorized persons in the neighbourhood of G-ALYY during its 24-hour stop at Rome on April 7th-8th. Capt. Bernado Russo, supervisor of Rome Air Control at Ciampino in April, then gave details, through an interpreter, of the last R/T. communication between G-ALYY and Rome: this was at 1858 hr G.M.T.

The next witness was Mr. R. H. W. Clarkson, B.O.A.C.'s station operations officer, who stated that a message from YY received at Cairo at 1905 had read, "I have left Rome at 1830. I am bound for Cairo where my estimated time of arrival is 2120. I am ascending to 35,500ft. My estimated tank weight is 36,051 kilos."

After referring to the emergency services which had been alerted after the lack of further communication from the Comet, Mr. Graham inquired about the subsequent action taken. The search and rescue action, Mr. Clarkson said, appeared to be well co-ordinated and as well organized as possible.

Dr. R. D. Teare was next recalled, and said that he had conducted post-mortem examinations on four of the victims of the Naples Comet accident. There was a general similarity between the injuries and causes of death of these four bodies, and also a similarity between these injuries and those of the bodies in the Elba accident. His conclusions were the same as those he had expressed on the third day of the Inquiry concerning the Elba victims.

The affidavits of three B.E.A. and B.O.A.C. employees at Ciampino, relating to the stop of YY at Rome, were next read to the court. Nothing unusual had occurred in the pre-flight preparations of the aircraft or crew, they stated.

(*Later evidence: page 669*)

CIVIL AVIATION

AND NOW—ALFA, BRAVO, CHARLIE

THE decision taken in 1951 to introduce a new phonetic alphabet is all too well known. It was intended that it should be standardized for airline and possibly military use all over the world. During the war the British Ack, Beer system had been abolished in favour of a standard allied system, the well-known Able, Baker, Charlie. When, later, Alfa, Bravo, Coca was first proposed it came in for a large share of criticism, so much so that a number of I.C.A.O. member countries refused to employ it. The whole concept of standardization therefore broke down and the best that could be agreed upon was a six-month trial period during which as many people as possible of as many different language groups as possible were encouraged to wrap their tongues round the new syllables.

But from the general tumult of abuse there eventually crystallized a series of valid objections, not the least of which was the feeling that since Alfa, Bravo, Coca had been developed by a group of people not directly concerned with the actual operational problems of phonetic alphabets, the airlines were being asked to use "untried equipment," while being held responsible for any failure that might occur. When lives might be at stake this was a serious matter. Other objections, particularly from British pilots, centred round the fact that such symbols as Nectar and Victor could be too easily confused and that, for instance, there seemed to be no valid reason for stretching the traditional Fox to Foxtrot.

It is true, however, that the Able, Baker, Charlie alphabet presented difficult and even insuperable problems in tongue twisting for those whose language group and pronunciation characteristics were widely separated from our own. A body was accordingly set up within I.C.A.O., having the title of United Kingdom Committee, to investigate Alfa, Bravo, Coca and to conduct what many must have hoped would be little more than a phonetic autopsy. The committee consisted of representatives of the aircraft operators, the fighting services, airline pilots and phoneticians.

The conclusions they reached, however, have now been embodied in a report shortly to be submitted to I.C.A.O. They are unanimous and it is recommended that a modified Alfa, Bravo, Coca should be adopted. The modifications suggested consist simply enough in the alteration of six of the Alfa, Bravo, Coca's symbols; *viz* Coca to revert to Charlie, Foxtrot to Fox, Metro to Mike and Extra to X-ray; furthermore, it is suggested that Nectar should blossom forth as Nugget and Union as Uniform.

After their deliberations, the working party of the U.K. Committee produced a report which embodies a study of the intelligibility of four phonetic alphabets by Dr. Elizabeth Roberts of the Medical Research Council in conjunction with the Aviation Operational Research Branch of the M.T.C.A. To make it clear just what Alfa, Bravo, Charlie is and what problems are entailed in its foundation, the working party's report has been published and is available on application to the M.T.C.A. (Telecommunications 9), 19-29 Woburn Place, London, W.C.1.

Trans-Canada's first Vickers Viscount completing its acceptance flights. It is one of 22 now being built for operation by T.C.A. in Canada and into America.

BRAN LIFT—AND DROP

AFRICAN airlines are not always able to confine themselves to the routine work of transporting passengers and freight on their routes. An instance of extra-curricular operations was one recently undertaken by West African Airways Corporation in answer to an S.O.S. stating that locust swarms were moving into the fertile crop-growing areas on the borders of Northern Nigeria and French West Africa, south of Lake Chad. A brief survey was immediately carried out in a Dove, and in the meantime seats and fittings were removed from a Dakota.

In conjunction with the Resident of Bornu Province a plan was worked out for the scattering of poison-impregnated bran and the main requirement was to deliver this bait in 50 lb double sacks to forces on the ground. The first drops were made accur-

During an emergency operation against locusts a West African Airways Dakota distributed 15 tons of poisoned bran to infested areas in two days. On the right, the aircraft is being loaded; left, the sacks are heaved overboard to those waiting below.

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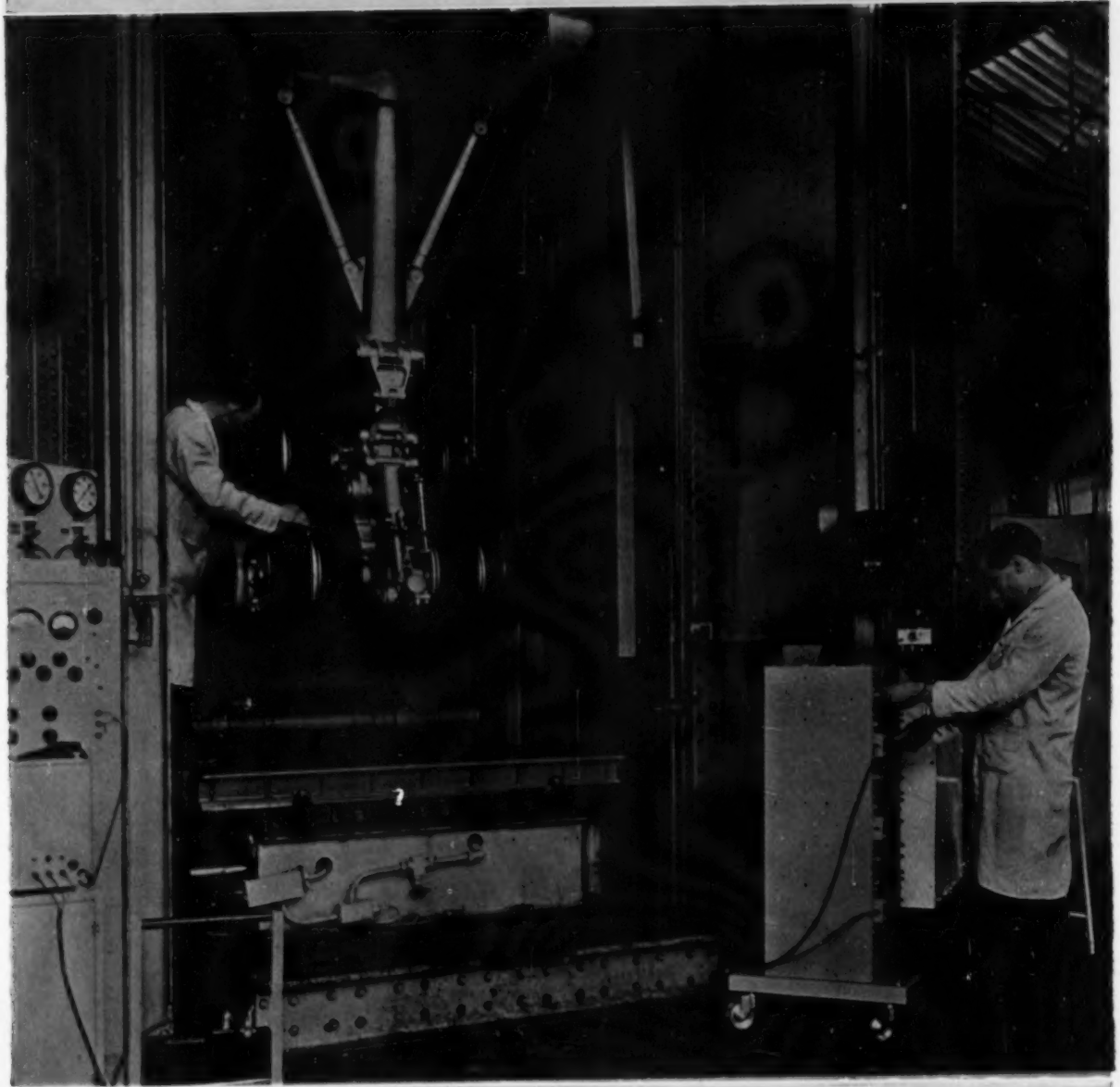

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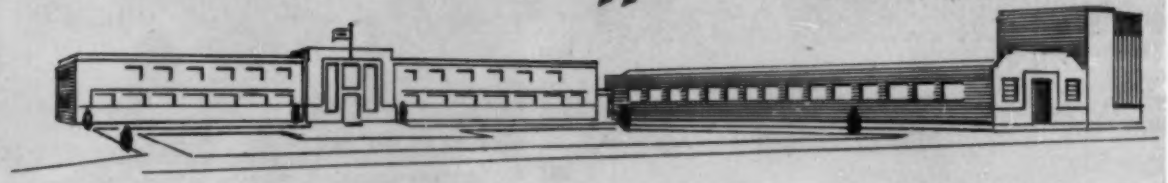

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CIVIL AVIATION . . .

As shown by this new study from Seattle, there is nothing unconventional about the Boeing 707's landing attitude. The prototype, now engaged on the second phase of flight trials, has reached a height of 42,000ft and has spent "a number of hours" at high Mach numbers.

ately from about 50ft but it was found that some of the sacks burst on hitting the ground. It was not possible to obtain other stronger sacks, so instead drops were attempted from even lower, and it was found possible to do the job successfully from as low as 20ft.

For the brief period of the operation Dakota G-AMJU was based at Maiduguri. In two days 15 tons of the bran was delivered precisely and then quickly scattered by natives assembled from the surrounding villages. The operation was largely successful, and from the pilots' point of view without hazard until the arrival of large numbers of hawks which were also attracted by the bran. This was one of several unusual duties undertaken by the Dakota before it returned to the U.K.

LYMPNE CLOSES

THE use of Lympne as an aerodrome for public use ceased on Sunday last, exactly four weeks after Silver City Airways transferred their remaining scheduled services to their new private airfield at Ferryfield. The M.T.C.A. states that former owners or their successors are being given an opportunity of buying back their land but that land not so bought back will be offered for sale by tender. "The possibility that the land may be bought for use as an aerodrome," says the Ministry cautiously, "is not excluded." Tenants of hangars and other buildings at Lympne are being permitted to remain on a day-to-day basis, and their aircraft are permitted to use the airport provided that they do not carry passengers for hire or reward. No other flying is allowed.

THE AMERICAN AIRLINES DISPUTE

A PRELIMINARY report has been published by Mr. David L. Cole, the neutral assessor appointed to settle the dispute between American Airlines and the Air Line Pilots' Association concerning non-stop coast-to-coast flights by DC-7s. It will be remembered that in July and August pilots of American Airlines conducted a 25-day strike in protest against the westbound schedule, which exceeded by an average of 35 minutes the maximum flight time of eight hours stipulated by U.S. Civil Air Regulations.

Mr. Cole held discussions for a period of two weeks with representatives of the airline and A.L.P.A. at Ithaca, N.Y., where he is a visiting professor at Cornell's Industrial and Labour Relations School. His preliminary report recommended that non-stop coast-to-coast flights should continue, "subject to conditions and restrictions to be worked out by the parties." He added that tensions had been so built up over the issue that it was wise to make only preliminary recommendations to serve as guides to the disputing parties. If they failed to resolve their remaining differences themselves he would make his final report and recommendations shortly after November 26, 1954.

WORLD AIR FARES AGREEMENT

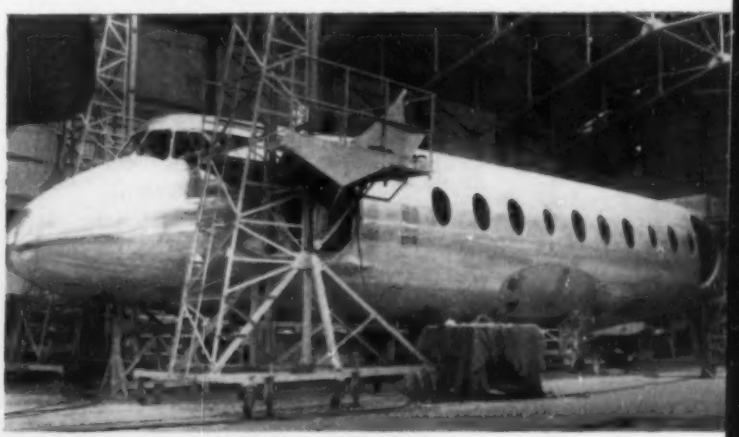
NO revolutionary decisions were reached at the 1954 sessions of the I.A.T.A. Traffic Conferences, which concluded last month in Venice. The function of the conference was to settle fares, rates and conditions of carriage on the international services of the 71 I.A.T.A. airlines for the twelve month period beginning April 1st next. Altogether nearly 500 resolutions were passed, the majority calling for slight increases—or, in fewer cases, decreases—in fares. As reported in *Flight* of October 22nd, detailed tables of some 30,000 individual rates and fares are now being drawn up for filing with governments by November 26th.

Delegates were unable to agree on a new programme of cargo rates for the North Atlantic and further discussions will have to be held between the 13 airlines directly involved before the existing agreements expire on March 31st. The problem here is that of reconciling two opposing philosophies; some airlines believe in attracting extra cargo traffic by offering big discounts for bulk shipments, while others feel that the existing system of special rates for specific commodities would, by further development, achieve the same end. The fact that the I.A.T.A. airlines collectively can move cargo from "anywhere to anywhere" means that the North Atlantic rates can influence traffic in most other areas.

In the western hemisphere the only major fare adjustment will be reductions of 7 to 8 per cent in tourist rates between Mexico City and Panama and some new excursion fares in the Caribbean area. In Europe, fares on some routes are being increased by 2.5 to 5 per cent in order to cover operating costs and to "iron out anomalies in the tariff structure which have come to light during the first full year of tourist services in that area."

The formation has been announced of a "European Creative Fares Board," which will ensure that the setting up of special fares for off-peak and night services will develop new traffic without diluting normal revenues. There will be few changes in

The first of Capital Airlines' Viscounts (right) is now taking shape at Hurn. Meanwhile, flight and ground staff are being taught to handle the new equipment. On the left is a class of Capital Airlines airframe engineers receiving instruction from Mr. W. C. Foster at Vickers-Armstrongs Aircraft Servicing School, Weybridge: (left to right) Mr. E. J. Almassy, Mr. V. H. Luecke, Mr. R. W. Hoffmaster, Mr. N. A. Stickley, Mr. T. J. Clifford and Mr. E. J. Hutchins.



The closing of Northolt as a civil airport (page 665) coincided with the withdrawal of Vikings from scheduled service with B.E.A. A Viking appears in the background to this study of Pionair G-AHCZ, which made the last scheduled departure from Northolt on Saturday last.

CIVIL AVIATION . . .

fares between Europe and the Middle East and Africa. Increases of up to 5 per cent will apply to fares between Europe and Dakar and also on the routes to Madagascar, Reunion and Mauritius.

"Equipment differential" fares, which permit operators of twin-engined unpressurized aircraft to charge less than the big airlines with more modern equipment, are being introduced within the Far East; they will, however, apply only to certain round-trip excursion services. There will be practically no alterations in fares over the North Atlantic. Next March a special working group is to meet in Bermuda to discuss ways of attracting more traffic during off-season months.

First-class and tourist fares were established for the new S.A.S. Polar services, a reduction of about £6 10s being allowed in view of the lesser distance. On South Atlantic routes existing fare-levels will be maintained, but operators of non-pressurized aircraft between Spain and South America will be permitted to introduce "B" services, costing about 20 per cent less than the normal tourist rate.

Delegates spent much time considering the "physical differences between first and tourist class services." A new list of minimum seating densities for aircraft now used on tourist services was adopted. In an attempt to indicate seating requirements for future aircraft, the conference adopted in principle a formula which takes into account floor space per passenger and which co-relates the width and the pitch of the individual seat.

S-55 CERTIFICATED

THE award of an unrestricted Certificate of Airworthiness for the Westland-Sikorsky S-55 helicopter was announced last week-end. This news coincides with the delivery, on October 31st, 24 hours ahead of the contract date, of the first of two S-55s ordered by B.E.A. The C. of A. covers all categories of operation including public transport for passengers, mail and freight.

On completion of acceptance tests, the first B.E.A. S-55 was flown from the manufacturers' airfield at Yeovil to Gatwick, the headquarters of the Corporation's Helicopter Experimental Unit, by Capt. J. H. Cameron, chief helicopter pilot of B.E.A.

Registered G-ANFH and named *Sir Ector*, the aircraft is fitted with seven passenger seats arranged in two banks of two facing rearward and one row of three facing forward. As in B.E.A.'s fixed-wing aircraft, seats are upholstered in dark red and the cabin interior is grey. This and the companion S-55, to be delivered during December, will be fitted with flotation gear enabling them to alight on water in the event of emergency; the weight of this gear will reduce payload to five passengers plus baggage. B.E.A. propose to use the two helicopters for a regular passenger service between London Airport and the South Bank city terminal, beginning in April next year.

Licensed production of the S-55 was begun by Westland Aircraft in 1951 and the first aircraft was ready for delivery to the French Navy in 1953. Subsequent deliveries of S-55s include five to S.N.C.A.S.E., five to British and Norwegian whaling companies and 20 (against an order approaching 100) to the Ministry of Supply for use by the Navy and R.A.F. The manufacturers state that the number of S-51s and S-55s so far delivered (more than 175) exceeds the combined total of all other European constructors of helicopters.

In the cockpit of B.E.A.'s first S-55 is Captain "Jock" Cameron; the cheery send-off is from Mr. E. C. Wheldon, managing director of Westland Aircraft, Ltd.; the occasion, reported above, was the handing-over of the newly certificated "Sir Ector."

BUSINESS TRAVEL ON CREDIT

FOLLOWING a concession by the Bank of England, residents of the United Kingdom and its Colonies and Dependencies can now take advantage of the Universal Air Travel Plan sponsored jointly by I.A.T.A. and the Air Transport Association of America. The plan enables holders of recognized credit cards to travel without cash payment in any part of the world on the routes of the 72 subscriber-airlines. The cards are issued in return for a £150 deposit from the holder or his employer.

Already nearly 180,000 cards have been issued in dollar countries and in Belgium and Switzerland, but until now currency restrictions have prevented their use by residents of sterling countries. It is thought that the Bank of England's decision may pave the way for similar concessions by other Commonwealth countries. The cards, which may be used only for business travel by holders in sterling countries, have no limit as to amount, time and area of travel.

The Universal Air Travel Plan, incidentally, should not be confused with the hire-purchase system lately introduced by American airlines; its purpose is simply to overcome the difficulty of carrying and exchanging large quantities of cash or travellers' cheques in order to buy airline tickets overseas.

AMERICAN DECCA

THE setting up of a wholly owned subsidiary in the United States has been announced by the Decca Navigator Co., Ltd. On October 28th a contract was signed in London between this new company, the Decca Navigator System, Inc., and the Bendix Aviation Corporation of Detroit, Michigan, under which the American firm will manufacture Decca Navigator transmitting and receiving equipment in America and will also be responsible for the exploitation of the Decca system there.

Commenting on the agreement, the Decca Navigator Co. says that the tie-up with an American manufacturer of the stature of Bendix must herald a major step in the advancement of the Decca system "if only because the new contract firmly establishes the fact that Bendix . . . have satisfied themselves on the intrinsic merits of the Decca system of navigation."

One of the immediate reasons for the agreement, it is thought, may be the lack of an American navigation aid for helicopters, an application for which European experience shows the Decca system to be extremely well suited.

TRIDAC, the largest electronic computer in this country and one of the largest in the world, was designed and built in collaboration with the Royal Aircraft Establishment by Elliott Brothers (London) Ltd.

Daily Telegraph

SYDNEY, Wednesday.

Mr. Beale, Australian Supply Minister, announced to-day that the largest electronic calculating machine of its kind in the southern hemisphere would soon be operating at the long-range weapons establishment at Salisbury, South Australia. The machine, which h... 1,750 va...

—AND NOW AGWAC

IN ADDITION to electronic computers for special requirements, such as Tridac and Agwac, ELLIOTT BROTHERS (LONDON) LTD. design and build analogue and digital electronic computers for the solution of complex problems in industry and science, with resultant economies in time, effort and cost.

Data handling ; the evaluation of trajectories in vital defence research; the prediction of strains in structures under extreme conditions ; the high-speed tabulation of mathematical functions ; these are typical of the varied computing problems in research and design now being solved on ELLIOTT Electronic Computers, with enormous savings in man-hours of calculation.

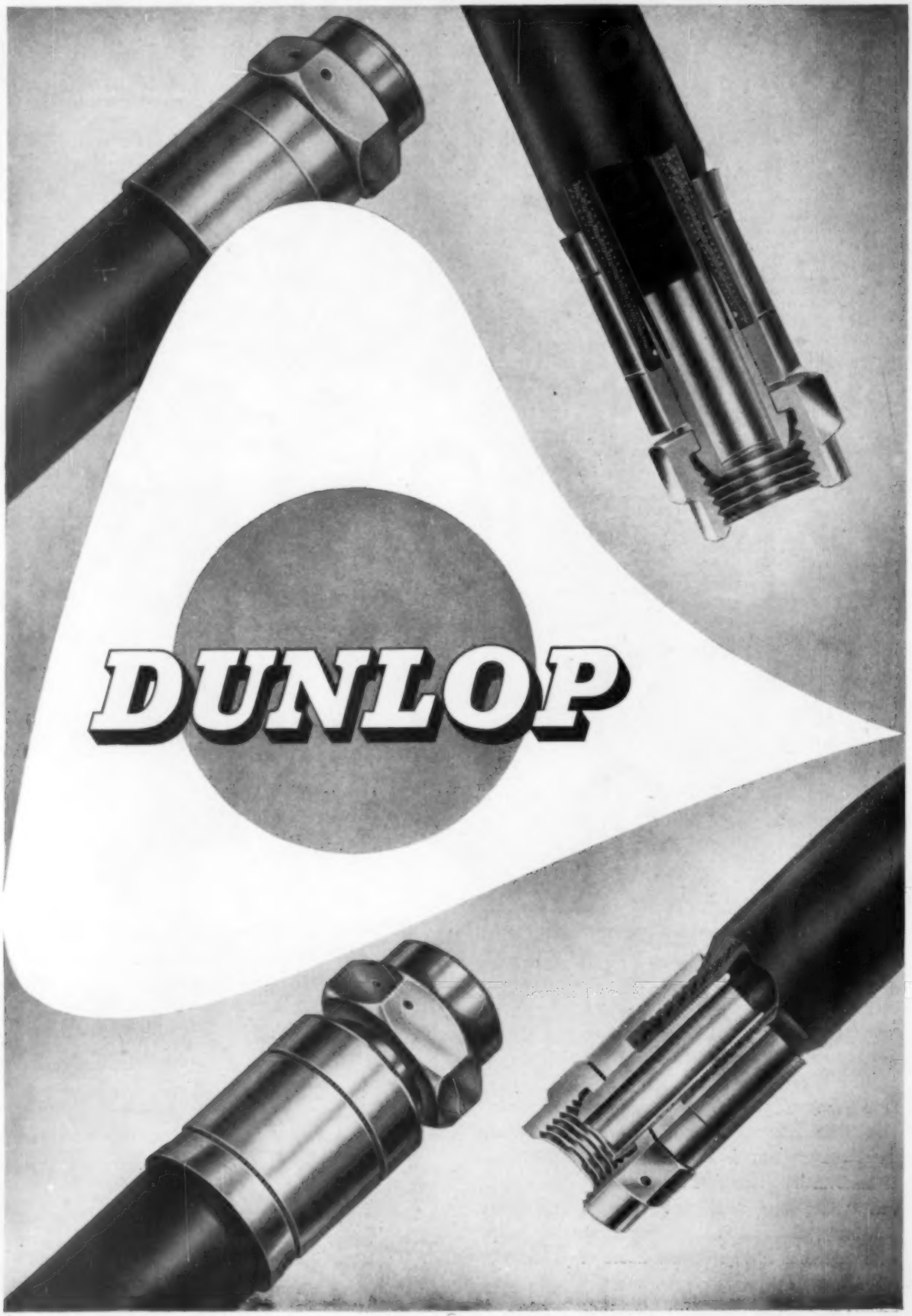
The Elliott Computing Service, staffed with Elliott mathematicians who have had years of experience in high-speed computing techniques, makes available to industry and science the use of electronic computers on a time-hire basis. This service is now being considerably expanded to meet increasing demands.

CONSULT

ELLIOTT

FOR COMPUTING

ELLIOTT BROTHERS (LONDON) LTD., COMPUTING MACHINE DIVISION, ELSTREE WAY, BOREHAMWOOD, HERTS. TELEPHONE : ELSTREE 2040


DUNLOP

CREATIVE CHEMISTRY & FLEXIBLE PIPES

Synthetics lend strength to Dunlop Hose

In Dunlop Flexible Pipes—the arteries of modern hydraulic, fuel, oil, coolant, oxygen, pneumatic and fire extinguisher systems—strength and security are basic essentials. The pipes must be able to absorb the most severe vibrations. They must be able to accommodate high impulsing pressures. They must be ready to damp or smooth out the high stresses set up by fluctuating pressures. They must possess long fatigue life. *They must in short, be utterly dependable.*

Same principle

Naturally, each flexible pipe—whether in the low, medium or high pressure category—is individually designed for the job it has to do. The principle of construction is, however, the same in all cases—the hose is built up of rubber (or rubber-like material) with textile or wire reinforcements adequate to the demands of pressure, length and volume change, and fatigue resistance.

The importance of the ability of the seamless extruded lining tube to resist the action of the fluid or gas that passes through it and to withstand extremes of temperature is obvious. Equally clear is the fact that conditions of service (though generally severe) vary enormously.

No one compound and no one basic material is suitable for every application. It is the devising and formulation of these materials that may be called 'creative chemistry'. In this field both natural and man-made (or synthetic) rubber can be compounded to meet the special demands of each application.

End Fittings

It is equally important that the metal end fittings shall be of sound engineering design so that the maximum efficiency and service can be obtained from all pipe assemblies.

In the high pressures range Dunlop lip-seal principle is used. This type of end fitting is unique and increases its sealing properties in proportion to the rise of pressure in the hose.

In the pressure ranges employing metal braid reinforcements, the tensile load is carried by the wire braid. Rubber displacement is thus reduced and bore obstructions due to 'cold flow' is eliminated.

Research Centre

In work of this type, Dunlop is particularly fortunate. Both in the factory and in the huge Research Centre at Castle Bromwich the Aviation Division has at its disposal what is probably the finest combination of experience and research skill available in the industry.

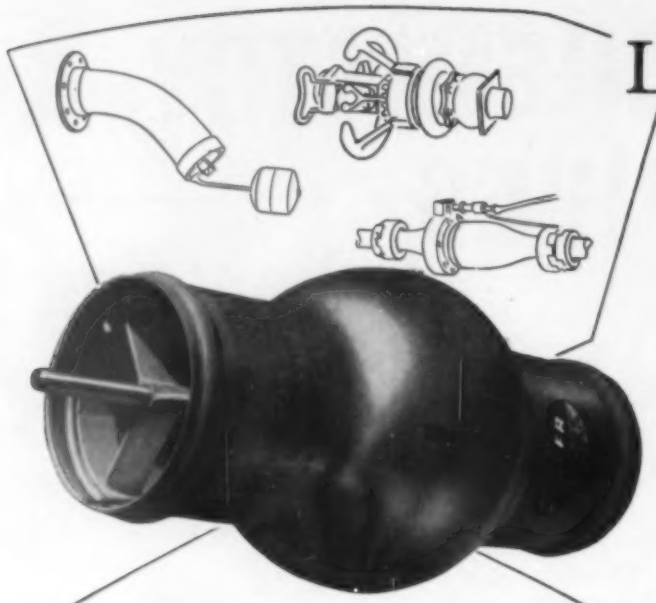
Dunlop flexible pipes combine the skill of the research chemist and the engineer. Their success is proved by performance—and by the number of famous manufacturers and famous aircraft with which they are associated.

Moulding by Vacuum

The use of laminated plastics for moulding radomes, wing tips, turrets and other structures is a growing practice in the aircraft industry.

The Dunlop Aviation Division is producing rubber vacuum moulding bags for use with this process. The bags are tailored to constructors' requirements and the rubber used is capable of withstanding temperatures of 140°C throughout the period of cure.

Dunlop makes things better for everyone



The FR Non-Return Valve—1·23 ozs., for ¾ in. size—is the lightest valve of its type in existence, is simple to install, and needs no servicing. Its low pressure loss, perfect sealing characteristics, low opening pressure and small overall diameter ensure its suitablility for many special applications. Available in sizes up to 3 in.

Conforms to International Pressure Fuelling Standards

LIGHTWEIGHT *champions!*

One reason for the success of FR pressure refuelling equipment is the extremely simple design and lightweight construction of each individual component. Generally acknowledged as setting to-day's standard of smooth, even flow with low-pressure loss, to ensure rapid turn-round, FR refuelling equipment is now also in growing demand for *marine craft* and *fighting vehicles.*

PRESSURE REFUELLING **F R** EQUIPMENT

FLIGHT REFUELLING LIMITED
Tarrant Rushton Airfield, Blandford, Dorset.
Telephone: Blandford 501. Telegrams: Refuelling, Blandford.

Dress wear by

AUSTIN REED

Of Regent Street

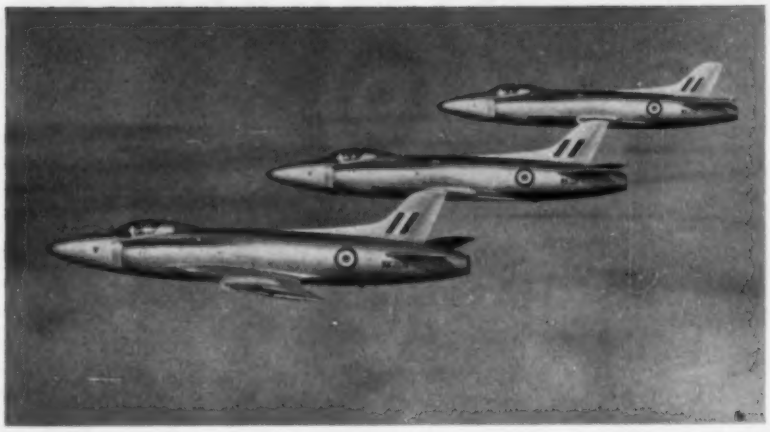
Woven exclusively for us, our dress wear cloth is moth-proofed and never varies in shade. Because of this identical black you can wear the same trousers with 'tails' or dinner jacket and replace a single article without having to order a complete new outfit.

Double-breasted Dinner Jacket 15½ guineas.
Trousers 7 guineas. Tail Coat 19 guineas.

LONDON AND PRINCIPAL CITIES

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News



An appealing study of Vickers-Supermarine Swift F.1s—one of numerous excellent photographs in the publication "Aircraft of the Royal Air Force," now being issued by the Air Ministry as a recruiting booklet. This publication is supplied free of charge to the young hopefuls who write to the Ministry asking for pictures of aircraft.

Royal Visit to No. 90 Group

WHEN H.R.H. the Duchess of Gloucester, Air Chief Commandant of the W.R.A.F., visits the headquarters of No. 90 Group at Medmenham next Friday, November 12th, the Queen's Colour of the R.A.F. in the United Kingdom will be paraded.

The Duchess will be received by A.V-M. J. G. W. Weston, C.B., O.B.E., A.O.C. No. 90 Group, and will watch a fly-past of six Lincolns, six Varsities and six Meteors from Watton, Norfolk.

No. 90 Group is a home formation under the direct control of the Air Ministry. Although bearing a group designation, it has in fact command status and administers and controls a number of establishments and units. The most important of these are the Central Signals Establishment, the Radio Engineering Unit and the Central Signals Area.

Wyvern Grounding

THE Wyverns operating with the Mediterranean Fleet were recently temporarily grounded as a routine precaution following two accidents. In the first accident a Wyvern from H.M.S. *Albion*, flown by Lt. B. Macfarlane, struck the sea and sank rapidly. The pilot operated his ejector seat under water and, though he is reported to have experienced some trouble from his parachute, which became deployed, and to have suffered some injuries, he escaped with his life. This is thought to be the first successful live under-water ejection in the F.A.A., but the whole problem of under-water ejection is already being studied at R.A.E. Farnborough, where dummies are being ejected under water and the effects of the operation studied.

Memorial Service

ON November 16th, at noon, a memorial service is to be held for Air Chief Marshal Sir Roderick M. Hill, at St. Margaret's, Westminster. Accommodation will be reserved for friends and representative bodies, and application for tickets should be made to Air Ministry [S.4 (d)], Whitehall Gardens, London, S.W.1, not later than November 6th.

Malayan Awards

THE following awards for distinguished service in Malayan operations appeared in the *London Gazette* for Friday, October 29th. The details concerning the awards are taken from the official citations.

C.B.E.

G/C. S. E. Mackenzie, who commanded Advanced Air Headquarters, Malaya, from November 1952 until February 1954, when the Headquarters moved to Kuala Lumpur. In this appointment, he was responsible for the co-ordination of all requests for air support from army and police units, and for planning and mounting the operations. Many of the procedures and methods now in use in Malaya were originally instituted and developed by him.

O.B.E.

W/C. A. D. Grace, D.F.C., who has been in charge of the administration of R.A.F. Station, Tengah, since November 1951, where administration has been far more difficult and complicated than is normal on the majority of stations. In spite of these difficulties, administration has progressed smoothly and efficiently and the fact that the personnel of all units have remained happy and contented is very largely due to the hard and conscientious work that W/C. Grace has performed. In addition to administrative work, W/C. Grace has flown 100 hours as pilot.

M.B.E.

F/L. G. M. Wade, Air Headquarters, who has nearly completed his tour in Malaya. He took an early and enthusiastic interest in the Jungle Rescue Team, which was established at Changi, and became its Training Officer. By his tireless efforts during evenings and week-ends, he brought the team to a high pitch of efficiency. When Air Headquarters Malaya moved to Kuala Lumpur and the Changi team was dissolved F/L. Wade immediately set about forming a new team at Kuala Lumpur which now consists of over 20 airmen. He has also become a qualified parachutist and has made 13 descents. F/L. Wade spends most weekends taking the team into thick jungle. He teaches jungle-craft, navigation, anti-ambush drills, the preparation of clearings for casualty evacuation and supply dropping, weapon training with sten and bren guns, rifles and grenades, and radio operating.

(*To be Continued*)

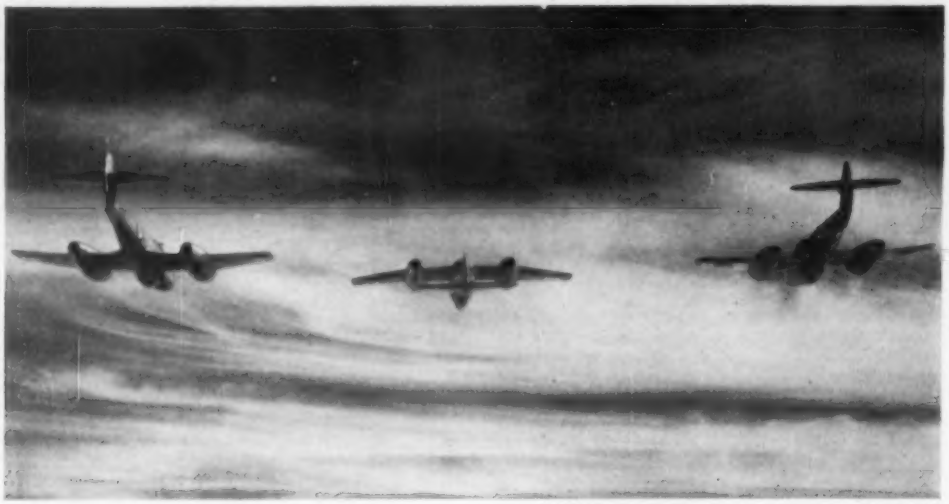
Pathfinder Party

ON Friday evening last the Pathfinder Club held its tenth annual party to celebrate the anniversary of the opening of the club premises in Mount Street. About 60 members attended the function, at which the usual candle-decorated horseshoe cake was cut.

The Scottish squadrons of the Royal Auxiliary Air Force recently held a ball in the Gleneagles Hotel, Perthshire. On the left the Duke of Hamilton (centre) is seen with F/O. J. N. Daly and Mrs. Daly at the ball. Below, W/C. W. G. Duncan Smith, Marshal of the R.A.F. Sir William Dickson and W/C. J. H. Scott are about to play a round of golf on the Kings Course at Gleneagles on the day following.

SERVICE AVIATION . . .

Barbara M. Pike with the Sash of Merit presented to her by A.V-M. Yarde, C.V.O., C.B.E., Commandant General of the R.A.F. Regiment, at a recent passing-out parade at the W.R.A.F. Depot, Hawkinge, Kent.



Against a background of high cirrus cloud, three instructors of the Ferry Training Unit at Benson disport themselves. They are F/L. A. W. Horner, F/L. J. Davis—who, perhaps, thought to fly that way because he hails from New Zealand—and F/S. F. Hicks, A.F.M.

A.V-M. J. G. Hawtrey

THE death occurred in San Remo, Italy, on August 26th of A.V-M. J. G. Hawtrey, C.B.E., who, since August, 1952, had been A.O.C., Iraq.

A.V-M. Hawtrey was born in June, 1901, and educated at Eton. He served during the war in the Middle and Far East, and in 1945 became A.O.C. No. 21 Group, Flying Training Command. In the following year he became Director of Intelligence (Operations) at Air Ministry.

Sea Devon C. Mk. 20

UNDER the above designation, ten Dove-type aircraft have been ordered by the Ministry of Supply for communication flying in the Royal Navy. They will be delivered during the spring of next year and will be powered by D.H. Gipsy Queen 70 Mk 2 engines driving D.H. 1000-type airscrews.

Helicopter Experimental Unit

IN a written reply in Parliament, Mr. Head, Secretary of State for War, revealed that 38 helicopters are now employed to meet the Army's needs. Of these, 24 are provided by the R.A.F. and 14 by the Royal Navy. About 100 helicopters are on order for the R.A.F. The first step towards the foundation of an independent Army helicopter unit is the establishment of a joint R.A.F.-Army Helicopter Experimental Unit under the jurisdiction of the Army. The unit is to study the use of helicopters as a means for providing greater mobility for the Army in the field.

"H" Reservists for C.D.

THE second reading was recently moved in Parliament of the Civil Defence (Armed Forces) Bill. This Bill is designed to provide for the training by the Home and Health Departments of certain National Service reservists so that they could be mobilized in time of war to form Civil Defence mobile columns.

The latest strategic considerations emphasize the need for such units, and the R.A.F. releases into the Class H reserve more men than it would immediately require to mobilize in the event of war. It is therefore proposed that certain Class H reservists shall be called up for 15 days in each of their three years of reserve service for training, first, in the technique of rescue work, second, for moulding into efficient rescue teams and third, for the formation of rescue columns. Other men who can only be spared for one 15-day period, or who are physically unfit for fire-fighting, yet have previous driving experience, would be employed to form mobile ambulance columns.

It is proposed to call up some 15,000 men for fire-fighting and rescue training during 1955-56, and for this purpose three establishments are to be built, equipped and manned at a cost of £375,000. The first men will be called for training in the early summer next year.

Finally, it is considered that in the event of a nuclear attack, members of the armed services would inevitably be called upon to assist in rescue operations, and plans are being considered to provide some form of rescue training in the forces for this purpose.

Little Rissington at Point Cook: Members of the Examining Wing of C.F.S. are greeted on arrival in their Valetta. (Left to right) F/L. M. J. Wilson, R.A.F.; S/L. L. M. Cairns, R.A.A.F.; F/O. L. G. Huddy, R.A.F.; W/C. T. S. Ingledew, R.A.A.F.; S/L. J. T. Lilleystone, R.A.F. and W/C. D. A. Wright, R.A.A.F.

Presentation

WHEN No. 68 Squadron held their reunion in London last month, S/L. Leete, a former commanding officer, presented on behalf of past and present members a silver tankard to Mr. L. W. Kohler for organizing the first ten reunions of the squadron.

No. 68 is a night fighter squadron, formed in 1942 by G/C. the Hon. Max Aitken, D.S.O., D.F.C., and operated Beaufighters and Mosquitoes. Disbanded after the war it was re-formed in 1950 and is now part of 2nd T.A.F.

No. 23 Squadron

A HISTORY is being compiled of No. 23 Squadron and the commanding officer, S/L. P. S. Engelbach, asks for relevant matter and photographs to be sent to him at R.A.F. Coltishall, Norwich, Norfolk.

Reunion

THE annual dinner of the R.A.F. Middle East 1914-1923 club will be held at the R.A.F. Club, Piccadilly, London, on Wednesday, November 10th. A.V-M. A. E. Borton will be in the chair.

Tickets (35s.) from S/L. A. D. L. Carroll, Langley, Saffron Walden, Essex.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The "R.E.8"

IN your issue of October 15th, may I draw your attention to the article by J. M. Bruce, M.A., concerning the "Harry Tate."

On page 577 of your issue it is stated, "The first squadron to be equipped with the type was No. 21 . . . in February 1917."

I think you will find that No. 52 Squadron was the first to be so equipped. I went overseas (France) with this squadron in November 1916, from Hounslow aerodrome.

In the early days of 1917 the casualties we had in accidents, spins, etc., had such a demoralising effect that they were exchanged with the B.E.2Es of No. 34 Squadron (then commanded by Major Blount).

Chichester, Sussex. T. A. M. RAWES,
(late S/L., R.A.F.)

[Mr. Bruce has seen this letter from S/L. Rawes and makes the following observations:—I am indebted to S/L. Rawes, not merely for his correction, but also for clearing up a matter which puzzled me greatly while I was writing the R.E.8 history.

I allowed myself to be misled by two apparently conflicting statements in Vol. III of "The War in the Air." I could find no explanation anywhere in the official history which resolved the conflict; yet the two separate statements are now proved to be correct in themselves.

In the footnote on page 285 of the volume in question it is stated: "Between October 1916 and April 9th, 1917, further squadrons arrived as follows: No. 52 (R.E.8), 16th November; . . ." Yet in Appendix XII, which gives the Order of Battle of the R.F.C. on 9th April 1917, almost five months later, the equipment of No. 52 Sqn is given as 18 B.E.2e's. In the absence of any explanation of this apparent retrogression I concluded that the first statement was incorrect, an assumption not so absurd as it might appear, for even the official history is not completely free from error.

S/L. Rawe's letter not only supplies the very necessary information to explain why No. 52 Sqn should have had first R.E.8s and subsequently B.E.2e's, but it emphasises admirably the dangerous nature of the early R.E.8.]

The R.T.1.

I WAS most interested to find a reference to the R.T.1 in the history of the R.E.8 appearing in your issue of October 15th.

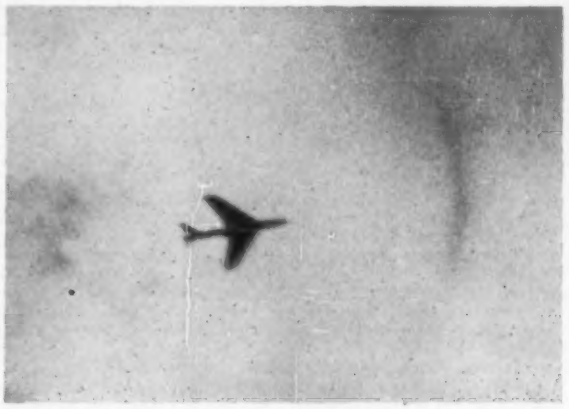
In my scrap-book of the 1914-18 war I have a faded snapshot with the caption "R.T.1. A mongrel aeroplane with R.E.8 fuselage, Bristol Fighter mainplanes, and 200 h.p. Hispano-Suiza engine." I took the snapshot early in 1918 when I was under flying instruction with No. 55 T.S. at Lilbourne, near Rugby, and remember the circumstances quite distinctly; in particular the speculation amongst the group on the tarmac as to what the strange aircraft approaching from the west could be—and our surprise when, having taxied to the hangar, the pilot and sole occupant removed his helmet and leather coat and produced from the rear cockpit a "brasshat" and a British-warm. What his name and rank were I do not remember, but he had flown from our wing headquarters at Castle Bromwich.

It was from this pilot's lips that we learned that his aircraft was an R.T.1 (Reconnaissance Type 1) and we gathered that it was some individual's idea, for a likely fighter-*cum*-bomber-*cum*-reconnaissance machine, to fit Bristol Fighter wings to an R.E.8 fuselage and increase the engine power. We were in no doubt as to the R.E.8 fuselage and Hispano-Suiza engine, but accepted his word about the mainplanes.

The fin was not marked R.T.1 as in your illustration, but I can decipher the number in my snapshot (painted large on the fin) as B6626.

I am glad to have had the confirmation of *Flight* that there was in fact such an aeroplane, for so many people have questioned the accuracy of the name R.T.1 in the caption to my snapshot. Can history confirm "my" R.T.1, I wonder?

Knaresborough, Yorks. H. C. W. SCOVELL



Neville Duke's Hunter and its shock wave referred to below.

Shock-wave Phenomenon

RATHER belatedly, I am enclosing a photograph which I took at the S.B.A.C. Display, showing what I presume to be a shock-wave preceding the Hunter 6.

I have seen plenty of pictures of shock-waves taken in wind-tunnels, but have not previously seen one recorded in the open air. No doubt the fairly high moisture-content in the air made the local compression visible to the camera.

I must apologize for the poor quality of the picture, but it is a considerable enlargement of one corner of the negative.

Guildford. W. L. HENERY,
Technical Director, Anticoustic, Ltd.

FORTHCOMING EVENTS

Nov. 6. British Interplanetary Society: "Medical Aspects of Flight above the Atmosphere," by Col. P. A. Campbell, U.S.A.F.

Nov. 6. British Interplanetary Society (Midlands branch): "Radar and Space Travel," by J. Nicoll.

Nov. 10. Radar Association: Talk on production of B.B.C. television film series, "War in the Air," by G/C. P. Dorte and J. Elliott (at Lime Grove Studios).

Nov. 10. Institute of Transport: Anniversary luncheon.

Nov. 11. R.Ae.S. Main Lecture: "Boundary Layer Control," by Dr. G. V. Lachmann, F.R.Ae.S.

Nov. 12. Helicopter Association: "Helicopter Production," by E. J. Boulger.

Nov. 16. R.Ae.S. Section Lecture: "Uses of the 'Ace' Computor," by Dr. E. T. Goodwin.

Nov. 17. R.Ae.S. Graduates' and Students' Section: "Bird Flight and the Aeroplane," by Capt. J. L. Pritchard, C.B.E.

Nov. 20. British Interplanetary Society (North-West branch): "Extra-Terrestrial Observatories," by C. A. Cross, M.A.

Nov. 20. British Interplanetary Society (provisional Yorkshire branch): "Space Vehicles," by D. A. Parish.

Nov. 23. Helicopter Association: Films, in association with the R.Ae.C.

Nov. 25. R.Ae.S. Section Lecture: "Development and Investigation of Fatigue Cracks," by Dr. N. Thompson, B.Sc.

Nov. 25-26. Institute of Metals: Discussions on papers dealing with titanium and other subjects.

Nov. 26. Lighter-than-Air Reunion, Londonderry House.

Nov. 27. British Interplanetary Society (provisional Scottish branch): "The Rocket as a Scientific Instrument," by H. W. Ovenden, M.A., B.Sc.

Nov. 27. British Interplanetary Society (provisional Western branch): "Possible Methods of Propulsion in Space," by L. R. Shepherd, Ph.D., B.Sc.

Nov. 30. Guild of Air Pilots and Air Navigators: 25th Anniversary Celebrations.

Dec. 2. R.Ae.S. Graduates' and Students' Section: "Seaplanes—Development of Water-based Aircraft Design," by R. F. R. Storey, B.Sc.(Stud).

Dec. 4. British Interplanetary Society: Annual general meeting.

Dec. 9. R.Ae.S. Section Lecture: "Problems of Structural Design," by D. James, B.Sc., A.F.R.Ae.S.

Dec. 10. International Federation of Air Line Pilots Association: Technical meeting on airborne radar.

Dec. 10. Helicopter Association: "Possibility of the Flight Simulator as a Training Aid to Helicopter Pilots"—informal discussion, to be opened by Norman Hill.

Dec. 10. Women's Engineering Society: Members' evening.

R.Ae.S. Branch Fixtures (to Dec. 10): Nov. 8, *Henlow*, "Schneider Trophy Races and Their Influence on Aircraft Design," by G/C L. S. Snaith; *Bristol*, "Exploration of Space," by A. C. Clarke. Nov. 9, *Belfast*, "New Materials for Aircraft Construction," by G. O. Jones.

Nov. 18, *I.O.W.*, junior members' evening. Nov. 19, *Belfast*, annual dinner; *Brough*, annual dinner dance.

Nov. 22, *Henlow*, "The Aeroplane and its Engine," by A. Cdre. F. R. Banks; *Belfast*, "Plastics in Aircraft," by H. Baker. Nov. 23, *Boscombe Down*, "Bird Flight," by Capt. J. L. Pritchard. Nov. 24, *Bristol*, "User Problems in Industry," by B. S. Shenstone.

Dec. 1, *Luton*, "Rubber."

Dec. 7, *Bristol*, "Living Machines," by W. Grey Walter. Dec. 9, *I.O.W.*, annual general meeting and film show. Dec. 10, *Bristol*, Christmas Ball (jointly with Inst. C.E., Inst. Mech.E. and Inst. S.E.).

FOR THE BOOKSHELF

"Mach One," by Mike Lithgow. Allan Wingate, Ltd., 12, Beauchamp Place, London, S.W.3. Price 12s 6d.

THE great advantage, amongst a few disadvantages, and the great merit of this book is that it was written by Mike Lithgow himself, and as such it is a most interesting personal document. In 151 pages Mike Lithgow, chief test pilot of Vickers Supermarine, tells of his flying life from 1939 onwards, not as a series of desperate climaxes and dramas in operational and test flying, but in a purely personal, level and often delightfully pungent style.

Short of a Saint Exupéry the most interesting aviation writer must be a test pilot because his professional approach to flying is of necessity analytical and accurate. The average man in the street may shiver delightedly at the supposed perils and complications of jet flying, but the pilot's approach to the whole problem is nearly always conditioned according to the average tension and satisfaction of the métier.

The value of *Mach One* is that the author has expressed the approach to and atmosphere of flying far more sincerely and accurately than, for example, a Pierre Closterman. Yet it is difficult from the level tones of the narrative to appreciate fully the peculiar hazards of flying from an aircraft carrier in such operations as the sinking of the *Bismarck* or the maintenance of a reconnaissance 200 miles out from a carrier 800 miles from land when a navigation aid is available only in the direst of emergencies.

One feels that the most worthwhile and, for Mike Lithgow, the most satisfying part of his aviation career began only when he achieved his ambition of attending the Empire Test Pilots' School and, as he puts it, got bitten by the bug of development test flying. One could wish that he had given a more detailed description of a most interesting sojourn at Patuxent River, the U.S. Naval Air Test Centre, and possibly that he had spent less time describing the ferrying of Attackers to Pakistan. The final chapters, however, are ample compensation for any shortcomings in what went before, even despite the fact that he has inevitably fallen between the two stools of blinding the lay reader with science and leaving the enthusiast technically unsatisfied.

In the final analysis *Mach One* will remain as a valuable human document and as such it is definitely worth a place on the collector's bookshelf.

"Royal Air Force 1939-1945," Volume III: "The Fight is Won," by Hilary St. G. Saunders. Her Majesty's Stationery Office. Illustrated. Price 13s 6d.

THE frontispiece illustration to this third and final volume of the history of Royal Air Force operations in World War 2 is a portrait of Marshal of the Royal Air Force Lord Portal of Hungerford. It is well chosen, for, as Chief of the Air Staff from 1940 to 1945, Lord Portal played a tremendous part in creating the British and Allied air supremacy that made victory certain in every theatre of war.

With him, in the final chapter, three other famous names are singled out for special mention—Tedder, Dowding and Harris. A fifth should be added; for it was by perpetuating the policy of Lord Trenchard—"attack is the key to air victory"—that these great leaders and their colleagues first won the Battle of Britain and then carried the war to the enemy's camp. In Germany, on the other hand, the deterioration of the Luftwaffe, from a balanced force of fighters and bombers in 1940 to an almost entirely defensive fighter force in 1944, left little hope of turning the tide of battle.

If the Luftwaffe had merely sent its night fighters ranging over our bomber stations in 1944-45, it would have achieved far more than by letting them wait in the skies over France and Germany. Instead, it mounted very few intruder raids in 1943, none in 1944 and only two in 1945, in one of which 19 aircraft of Bomber Command were shot down over or near their bases—a dreadful hint of what might have been.

Scores of other lessons can be learned from this book: the vital importance of photo-reconnaissance; the futility of expecting quick victory to follow concentrated bombing of "panacea" targets such as ball-bearing factories; the ever-present need to counter the menace of the submarine; the value of minelaying from the air, which accounted for 32 per cent of all German ships sunk or damaged; and—a lesson we have already forgotten—the ability of flying-boats to do some jobs that no other aircraft can do.

Most important of all, the reader is shown that there must be no question of a choice between quality and quantity. The free world can survive only if it has a big enough force of the world's finest aeroplanes, manned by the right kind of crews, to ensure air supremacy through attack right from the start of any war.

Mr. Saunders paints a vivid picture of what such a force can achieve. We see how Hitler's almost invincible war machine was shattered and routed by the overwhelming might of Allied air power. Panzer divisions lost half their strength before entering action. Transport in the Cherbourg area became so pathetic that U-boats had to be used to carry anti-tank ammunition.

The immense achievements of armies and navies are not belittled. But victory rode on the wings of the rocket-firing Typhoons that choked the fields, roads and ditches of Falaise with death; the Halifaxes and Lancasters which laid the carpets of bombs over which our troops advanced; the precision-bombing Mosquitoes; and the ceaseless work of Coastal Command to control the seas.

The lessons are duplicated in the chapters dealing with the Far East. Indeed, the campaign in Burma might not have been possible at all but for Allied air supremacy. We tend to think of air supply as a fairly new idea, dating from the Berlin Air Lift of 1948-49. Yet, in Burma, Allied armies of 356,000 men were maintained in the field solely through air supply, by 17 squadrons of transport aircraft which did the work of many thousands of lorries in an area where lorries could not have been used at all. Nor is air evacuation a recent product of the Korean War; for 110,761 wounded were flown to safety in Burma, many of them by tiny liaison aircraft from clearings inside enemy territory.

There is much more of interest and enduring value in this book. Details are given of some of the war's "secret weapons," such as the Azon radio-controlled bomb; "canned battle"; radio countermeasures (including use of the Fuhrer's own voice to jam enemy broadcasts!); the German "Aphrodite"; and "Thetis." And the "let's-not-be-beastly-to-the-Japs" brigade might like to read about the Ghurka soldier who was flown to hospital in excruciating pain after being bound to a tree with strips of flesh cut from his thighs and legs by these little gentlemen.

To overcome such evil cost the lives of 70,253 aircrew of the Royal Air Force killed and missing in action, not counting all those who died in training and non-operational accidents. Their achievements, and those of their colleagues who survived, in terms of such things as bombs dropped, enemy ships and U-boats sunk, are summarized in cold, impersonal statistics in the final chapter and the 13 appendices. But there was a glory in their deeds that far outshines mere columns of figures.

"Aircraft Recognition Manual," by C. H. Gibbs-Smith. Putnam and Co., Ltd., 42 Great Russell Street, London, W.C.1. Fully illustrated. 10s 6d.

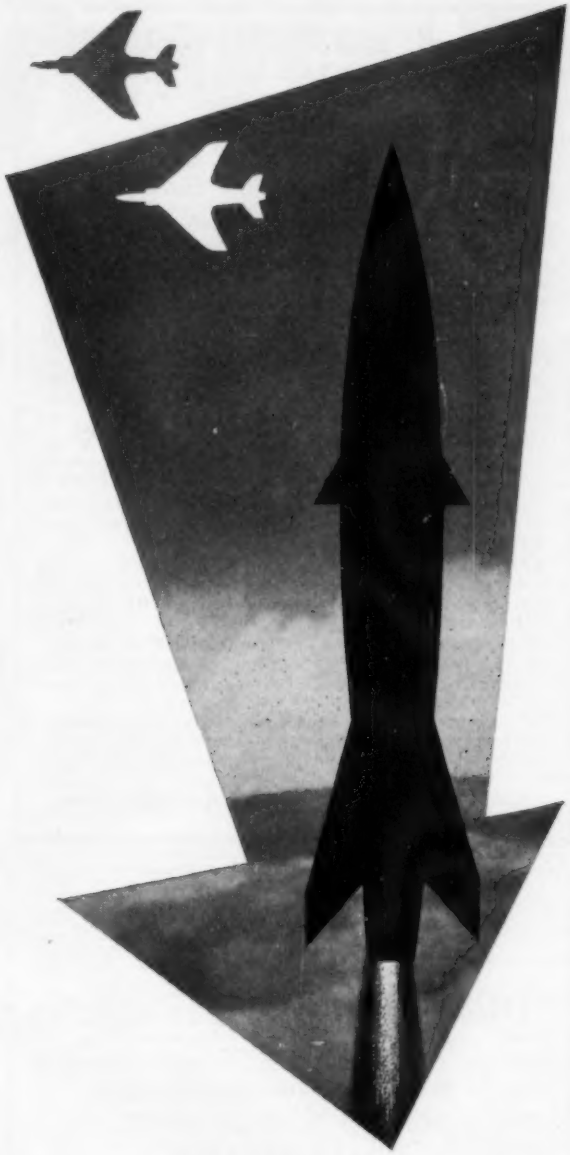
THIS new edition of what used to be called *The Air League Aircraft Recognition Manual* contains photographs, silhouettes and descriptive notes on some 200 aircraft. It is one of the very few books on the market which attempts also to give basic instruction in the art of aircraft recognition. Experienced spotters might wince at references to the Neptune's "prim face with pronounced Adam's apple," and to the Saab J-29 as "a species of globe-fish which can puff out its belly to look larger than life"; but such comparisons often stick better in the mind of a beginner than the conventional "high aspect ratio sweptback shoulder wing" kind of instruction.

A few of the criticisms of the earlier books still apply. The silhouettes are small and badly positioned for quick reference. Some of the photographs are trimmed too close to noses, fins and wing-tips; and old blocks showing, for example, prototypes of the Venom F.B.1, Panther, Saab 29, Hunter, Varsity and Hastings should have been replaced. But the new edition appears to set a high standard of accuracy, which is vitally important in a book of this type.

"The Boys' Book of Aircraft," by Laurence C. Bagley. Blackie and Son, Ltd., 16 William IV Street, London, W.C.2. Fully illustrated. Price 3s 6d.

THIS little book is worth buying for its colour drawings alone, because they are both technically accurate and artistically excellent. Instead of producing mere pretty-pretty portraits of aeroplanes, Mr. Bagley has captured something of the character of his 31 subjects, by showing them in action. His Sabre taking off looks, characteristically, like a goldfish floating up to an ant's egg. The others include a Sabre pilot's view of a Mig-15, a superb picture of a Wyvern dropping its torpedo and a Viscount being serviced in the B.E.A. hangars at London Airport.

The text is not quite so happy. Some details are out of date; there are one or two mistakes (first flight of the Gannet was September 19th, 1949, not 29th); and the recognition features are a little naïve in places, although we must admit that the idea of an "outside fin and rudder" rather appeals to us!



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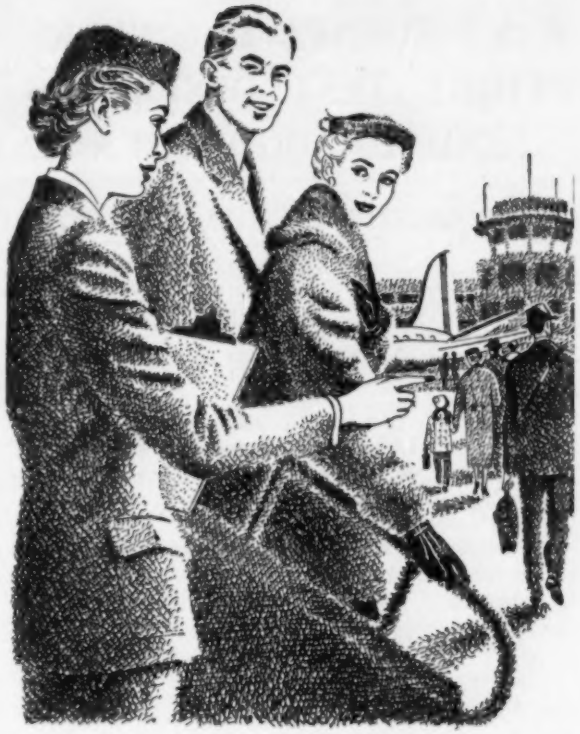

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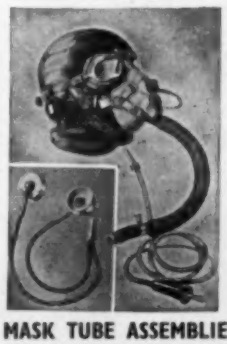

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PUBLIC ANNOUNCEMENTS

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 387 (amended) from Silver City Airways Ltd., of 1 Great Cumberland Place, London, W.1, for a seasonal vehicle ferry service with Bristol 170 aircraft for the carriage of vehicles, passengers and supplementary freight between Ferryfield and Basle at a frequency of from two to 14 services weekly during the season from mid-December to the end of the Easter holiday period each year, for seven years, from December 1955.

FROM Airwork, Ltd., of 15 Chesterfield Street, London, W.1:—

APPLICATION No. 401 for a seasonal inclusive tour service, in conjunction with Harold Ingham, with Viking aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Tangier at a frequency of three services during the season from the last Saturday in July to the last Saturday in September each year, for a period of seven years, commencing July 30th, 1955.

APPLICATION No. 402 for a seasonal inclusive tour service, in conjunction with Harold Ingham, with Viking aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Catania, at a frequency of three services during the season from the first Saturday in August to the first Saturday in October each year, for a period of seven years, commencing August 6th, 1955.

APPLICATION No. 403 for a seasonal inclusive tour service, in conjunction with Harold Ingham, with Viking aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Malta, at a frequency of three services during the season from the first Saturday in August to the first Saturday in October, each year, for a period of seven years, commencing August 6th, 1955.

APPLICATION No. 404 for a seasonal inclusive tour service, in conjunction with Harold Ingham, with Viking aircraft, for the carriage of passengers and supplementary freight between London (Blackbushe) and Lisbon, at a frequency of three services during the season from August 12th to October 12th, each year, for a period of seven years, commencing August 12th, 1955.

APPLICATION No. 257/2 from Airviews, Ltd., of Ringway Airport, Manchester, for traffic rights between Southampton (Eastleigh) and Isle of Wight (Bembridge) on their seasonal U.K. internal service on the route Manchester-Southampton (on demand)—and the Isle of Wight (Application No. 257) which has been approved, at a frequency of one to two return flights per week, by the Minister of Transport and Civil Aviation.

APPLICATION No. 405 from Eagle Aviation, Ltd., of 29 Clarges Street, London, W.1, for a seasonal inclusive tour service, in conjunction with Sir Henry Lunn, Ltd., for the carriage of passengers and supplementary freight between London (Blackbushe) and Zurich (Kloten) at a frequency of one service fortnightly during the season from May to August inclusive, each year, for a period of seven years, commencing May 1st, 1955.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [2831

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required for a number of posts in the Research and Design Laboratories of an advanced Guided Missile project. The work is interesting and prospects for advancement are good. For most of these posts graduates are required, or applicants holding National Certificate or City and Guilds with some practical experience. Lack of these qualifications should not prevent application being made as each case will be considered on its merit. (Ref. 80.)

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(*d*) **Designers, Technical Engineers and Aerodynamicists** in the Helicopter Design Offices.

Here, helicopter experience is desirable.

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SAUNDERS-ROE, Ltd., have vacancies for a limited number of experienced aircraft draughtsmen in their design office at Osborne, I.o.W. Applicants must have several years' experience of designing aircraft structures and should possess at least an Ordinary National Certificate.

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DESIGNERS and developments engineers required to meet expanding business. These appointments offer exceptional opportunities to men with initiative.—Applications to be sent to Personnel Manager, Joseph Lucas (Gas Turbine Equipment) Ltd., Shaftmoor Lane, Hall Green, Birmingham 28. [2826

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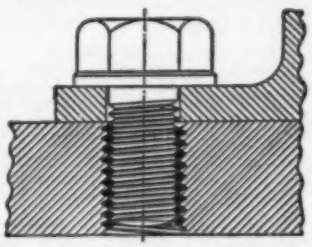

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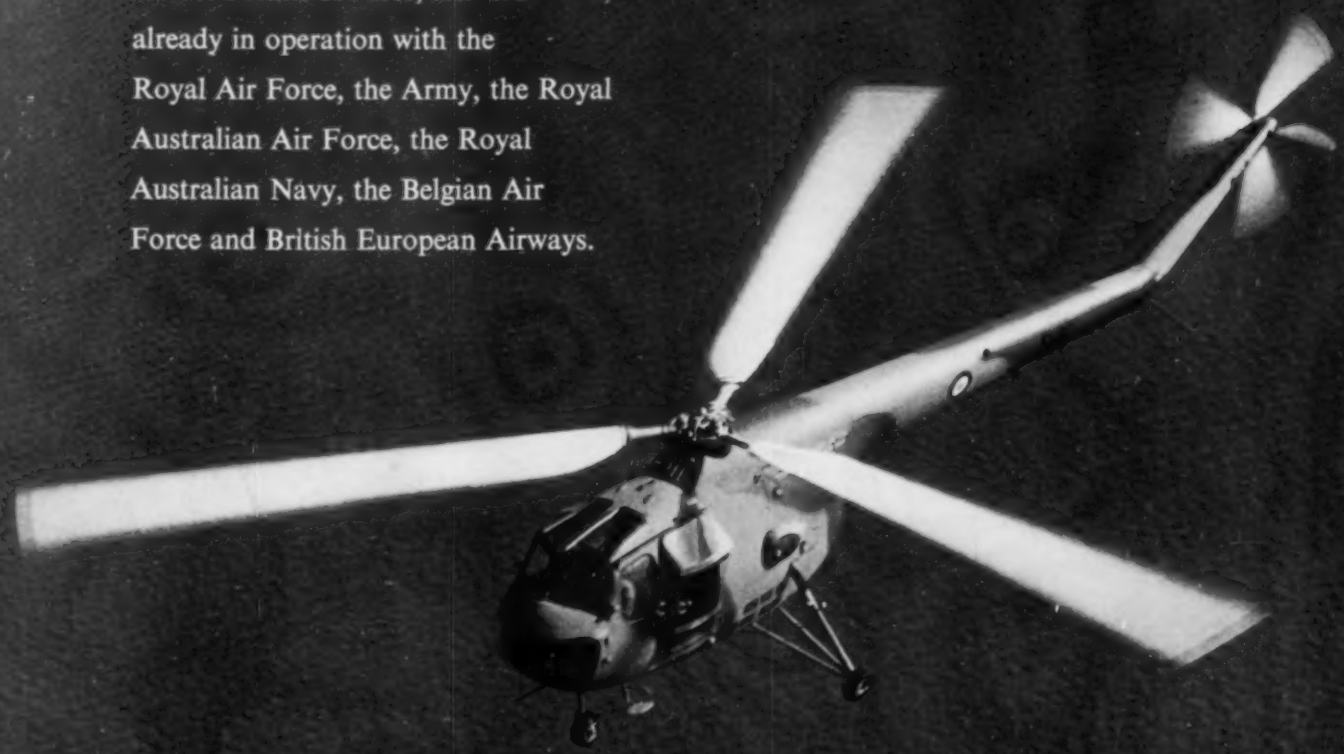

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